SOFIA Platform Generic Supplier Statement of Requirements

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SOFIA Platform Generic Supplier Statement of Requirements

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TABLE OF CONTENTS

EXECUTIVE SUMMARY 1
Introduction 1
Authority 1
1.0 SCOPE 1
1.1 Order of Precedence 1
1.2 Tailoring and Exceptions 2
1.3 Definitions 2
2.0 APPLICABLE DOCUMENTS 12
2.1 NASA Specifications and Standards. 12
2.2 Other Specifications and Standards Documents 13
3.0 ACCESS, SITE AND OTHER PRIVILEGES 13
4.0 QUALITY MANAGEMENT SYSTEM 13
5.0 CONFIGURATION CONTROL 13
5.1 Common or Limited Access Website 14
5.2 Redlines 14
5.3 Supplier Developed/Controlled Software 15
5.4 Design Agent Responsibilities 16
5.5 Substitute Parts 16
5.6 Configuration Baseline 16
5.7 Development Baseline (DBL) 16
5.8 Functional Baseline (FBL) 16
5.9 Physical Configuration Audit (PCA) Baseline 16
5.10 Product Baseline (PBL) 17
5.11 Flight Test – Software Loads 17
5.12 Insight Only - Software Changes 17
5.13 Documentation – Generic Requirements 17
6.0 DATA ANALYSIS PLAN (DAP) 17
7.0 RECEIVING INSPECTION 17
8.0 METROLOGY, CALIBRATED EQUIPMENT/TOOLS 17
8.1 Recording of Calibrated Item On-Aircraft 18
9.0 GOVERNMENT MANDATORY INSPECTION POINTS (GMIP) 18
10.0 TRACKING OBSOLESCENT PARTS 18
11.0 GOVERNMENT INDUSTRY DATA EXCHANGE PROGRAM & NASA ADVISORIES 19
12.0 LIMITED LIFE ITEMS 19
13.0 LIFETIME TEST 19
14.0 RECORDS, DATA MANAGEMENT 19
14.1 Proprietary/Sensitive/Classified Information/Products 19
14.2 Data Management 20
14.3 Engineering Data Package 21
14.4 Manufacturing Data Package 21
15.0 ENVIRONMENTAL REQUIREMENTS 21
15.1 Qualification Units 22
16.0 ELECTRO-STATIC DISCHARGE (ESD) 22

17.0 HAZARDOUS, EXPLOSIVE, COMBUSTIBLE MATERIALS/FUELS 22
18.0 FLIGHT TERMINATION SYSTEM (FTS) 22
19.0 FLIGHT WORTHINESS 23
20.0 GOVERNMENT FURNISHED EQUIP/PROPERTY/INFO (GFE/GFP/GFI) 23
21.0 GENERIC DESIGN REQUIREMENTS 23
21.1 Preliminary Design Review (PDR) 24
21.2 Critical Design Review (CDR) 27
21.3 Connectors/Cables/Harnesses 28
21.4 Growth 29
21.5 Start-Stop, Boot-up 29
21.6 Warm-up 29
21.7 Flight Test Vehicle Power 29
21.8 Overload Protection 29
21.9 Momentary Power Interruption 29
21.10 Interlock Shutdown – Data 30
21.11 Protection – High Voltage 30
21.12 Stored Energy Personnel Protection 30
21.13 ESD Sensitive Components 30
21.14 Reset Switch 30
21.15 Reliability 30
21.16 Calibration and Initial Settings 30
21.17 Flammable/Toxic Materials 30
21.18 Human Factors, Displays 30
21.19 Displays 31
21.20 Switches and Controls 32
22.0 FLIGHT TEST DATA INSTRUMENTATION 33
23.0 IN-PROCESS AND FINAL AUDITS 33
23.1 Audit Process 34
23.2 Pyrotechnics 36
23.3 Tamper Indicators 36
23.4 Stamp Control, Warranty, and Procedures 37
23.5 NASA/DFRC Approved Sources 37
24.0 MARKING 37
25.0 NON-CONFORMING MATERIALS, DEFICIENCIES/CORRECTIVE ACTION 38
25.1 Unexplained Anomaly (Cannot Duplicate) 39
25.2 Repair/Rework 39
26.0 SIMULATION 40
27.0 PACKAGING 40
28.0 PRINCIPAL CONTACTS 41
29.0 SAFETY / HAZARDS 41
30.0 PERSONNEL PROTECTION EQUIPMENT (PPE) 41
31.0 SOFTWARE 41
32.0 SPARES 42
33.0 STRUCTURES /LOADS 42
34.0 TEST AND ACCEPTANCE 42

34.1 Advance Notice 42
34.2 Test Readiness Review (TRR) 43
34.3 Formal Test 43
34.4 Informal Test 44
34.5 Final Acceptance 44
35.0 FIRST ARTICLE INSPECTION (FAI) AND FIRST ARTICLE TEST (FAT) 45
36.0 RECYCLED/USED PRODUCT 46
37.0 OPERATION PRECONDITIONING (BURN-IN TEST) 46
38.0 TOLERANCE 46
39.0 WORKMANSHIP STANDARD(S) 46
40.0 WARRANTY 46
41.0 SHIPPING INSTRUCTIONS 47
41.1 Hardware/Software Products Destination 47
41.2 Other Products Destination 47
42.0 INCIDENT/ACCIDENT INVESTIGATION SUPPORT 47
43.0 SOFIA PROGRAM SURVEILLANCE OUTLINE (QA RISK MITIGATION) 48
44.0 INTEGRATED PRODUCT TEAMS (IPTS) 49

TABLE OF FIGURES

FIGURE 1. TAMPER INDICATOR (CONNECTOR) - GREEN STRIPE 36
FIGURE 2. TAMPER INDICATOR – "EGG SHELL/ONION SKIN" QUALITY SEAL 36

TABLES

TABLE 1. DISPLAY POINT DEFECT REQUIREMENTS 31
TABLE 2. DISPLAY CLUSTER DEFECT REQUIREMENTS 31
TABLE 3. DISPLAY NON-UNIFORMITY BLEMISH REQUIREMENTS 32

APPENDIXES

APPENDIX A. DATA ANALYSIS PLAN – EXAMPLE A-1
APPENDIX B. INSTRUMENTATION PARAMETER LIST - SAMPLE B-1

EXECUTIVE SUMMARY

The purpose of this Supplier Statement Of Requirements (SSOR) is simply to provide written "customer expectations" and requirements to assure total product and/or service quality upon delivery to NASA Dryden Flight Research Center (DFRC) through its procuring agent, the Contracting Officer.

Compliance to the Contract obligations including this SSOR will enable cost efficient contract or agreement execution to meet all objectives and deliver products and services on schedule. This, in turn, will result in the best possible outcome for mission and safety. Success of the SOFIA Platform is important to NASA/DFRC, our partners and ultimately the public.

Introduction

DFRC is dedicated to safe, efficient operation of the SOFIA Platform flight research activities, which often utilizes existing, as well as new and emerging, technologies products and services to advance technology for the benefit of the United States, its citizens and technology partners. This SSOR is written for the application of requirements upon contractors, subcontractors, vendors, distributors, technology partners, etc. hereafter called the "Supplier". The Supplier of products and services to the SOFIA Platform Project shall comply with the requirements herein unless otherwise specified, or modification or exception identified in the contract, purchase order, memorandum of agreement, etc., hereafter called the "contract" with the Supplier.

Authority

The NASA/DFRC Contracting Officer (CO) alone is authorized to commit the Program and Project.

1.0 SCOPE

This SSOR defines generic requirements applicable to the Supplier. The Supplier shall be responsible for compliance to these requirements for all products, supplies, and services as well as to assure compliance at subcontractor, vendor and subordinate levels (hereafter referred to as "subcontractor") including NASA directed sources.

Some of the numbered elements of this SSOR (herein) may not be applicable to the Supplier. See the contract for applicability or exception. Where mute, all elements apply in full.

The words "guidance", "must", "shall", "will" and "may" have specific meaning for this contract. See Definitions for those meanings.

1.1 *Order of Precedence*

This SSOR does not relief or modify any legal obligations applicable to the products or services provided by the Supplier. In the event of conflict discovered between the Contractor(s), supplier(s), NASA Center(s) and Project requirements, the order of precedence shall be defined as:

A. Contract (including any contract modifications, updates, contract modifiers such as RDW, ECP, etc.)

B. Project governing SOFIA documents, such as the CMP, SDP, as well as Program level governing documents

C. This SSOR

D. Invoked documents and requirements including but not limited to:

1. CO/COTR provided drawings, specifications, governing documents, NASA specifications, NASA processes, Federal, FAA, and Military Specifications
2. Government's workmanship criteria
3. Baselined production drawings and performance specifications
4. Drawing referenced Specifications
5. Industry Standards, e.g. AS9100
6. Supplier's design documentation for this contract
7. Supplier's baselined drawings
8. Supplier's processes, standards, practices, procedures and Supplier invoked documents

1.2 *Tailoring and Exceptions*

Supplier proposed tailoring of, and exceptions to, requirements imposed by standards, performing organization procedure/processes, etc. shall be submitted to the COTR for written approval prior to implementation of the variance using a request for Deviation/Waiver

The Supplier remains responsible for ensuring compliance to all engineering and quality assurance requirements, including identification of critical or complex tasks, test witnessing, product verification inspections, material certification, special processes, control of records, and government mandatory inspections.

1.3 *Definitions*

The following definitions apply to terms or acronyms found within this SSOR or related documentation.

ADM	Advanced Development Model is a prototype closely resembling the final airworthy qualified product in fit and form, is functionally identical, but is otherwise noncompliant with requirement(s) or insufficiently tested to be airworthy. ADM may be used for formal (First Article) testing of flight software
Airworthy	Determined by the COTR to be compliant with requirements sufficient to be flown for project purposes with acceptable risks. It must be safe to personnel and public, property and mission through the entire flight regime.
AFSRB	Airworthiness and Flight Safety Review Board
Anomaly	Unconfirmed or potential failure requiring further investigation prior to acceptance.
Approval	Work shall not be implemented until NASA approval is obtained in writing. Approval or disapproval of engineering design products will occur within the specified action period. Unless specified otherwise this shall be 30 days for

	minor items or otherwise through COTR. In the event such approval is not obtained within the specified action period, the COTR will provide redirection in writing to allow implementation of approved portions of the work pending final approval.
Baseline	The approved and defined configuration of hardware, software, or systems at a discrete point in time in its life cycle and placed under Configuration Control.. See **Configuration Control** element.
Best Commercial	Supplier's published practice or acceptance criteria is either acceptable to the COTR or meets, or exceeds, ANSI/IPC-A-610A, class 2 or ANSI/IPC J-STD-001. Functional items or representative sample(s) shall be tested to pass/fail criteria, which is auditable, uniform, repeatable and traceable to design documentation. When a problem is discovered/reported the Supplier's corrective action shall resolve the problem at root cause and shall be focused on prompt internal and COTR satisfaction.
CCB	Configuration Control Board - the functional body responsible for establishing baselines and reviewing and disposition of all changes, deviations, and waivers to these baselines (if not identified otherwise within this document, refers to NASA/DFRC project).
CDR	Critical Design Review, Mandatory Inspection Point for deliverable CIs
CI	Configuration Item. An aggregate of hardware, firmware, software, or any of its discrete portions, which satisfies an end-use function and whose configuration shall be managed. CIs may vary widely in complexity, size, and type. A CI can be identified as a Hardware Configuration Item (HWCI) or a Computer Software Configuration Item (CSCI).
CIMS	Calibration Information Management System used by NASA/DFRC
Class A	See the Project Software Development Plan
Class B	See the Project Software Development Plan
Class C	See the Project Software Development Plan
Class D	See the Project Software Development Plan
CM	Configuration Management. The task of implementing and accomplishing, in an optimum manner, the four sub-tasks of configuration identification, configuration control, configuration accounting, and configuration verification over the life cycle of a CI to accomplish the following tasks: 1. Identify and document the functional and physical characteristics of a CI. 2. Control changes, deviations, and waivers to these technical requirements. 3. Record and report change processing and implementation status. 4. Verify that the configuration of systems and CIs are as specified in configuration identification documentation.
CM Documentation	The program/project-specific technical documentation (drawings, parts lists, specifications, standards, interface control documents/drawings, and documents invoked therein) that identifies and defines the item's functional and physical characteristics. The configuration documentation is developed, approved, and

	maintained by the Design Agent. This can be accomplished through increasing levels of detail, specifically: functional configuration documentation; the development configuration documentation; and the product configuration documentation.
CMP	Configuration Management Plan, Project governing document See 4.0.
Commercial	A commercial product is an item that has been produced for sale in the commercial marketplace that may conform to military specifications (MIL-SPEC) or using government standard parts only by coincidence and may be designed and/or built with changing processes.
Component	An assembly or any combination of parts, subassemblies, or assemblies mounted together, such as a transmitter or cryogenic pump.
Configuration	The functional and physical characteristics of a product (hardware, firmware, software, or a combination thereof) to be or as defined in technical documentation and achieved in a product. Sometimes abbreviated "Config".
Config Audits	Formal examinations of design and manufacturing documents, records, inspection histories, certifications, measurements, to determine whether a CI conforms to configuration documents.
Config Control	The systematic definition, evaluation, coordination, and disposition of each proposed change, deviation, or waiver, and the implementation of each approved change in the configuration of a CI after formal establishment of configuration identification.
Config Identification	Configuration identification includes the assignment of CIs; the determination of the types of configuration documentation required for each CI; the issuance of numbers and other identifiers affixed to the CIs and to the technical documentation that defines the CI configuration, including internal and external interfaces; the release of CIs and their associated configuration documentation; and the establishment of configuration baselines for CIs. Unless identified otherwise by the Design Agent, typically this shall be by descriptive title, part number and, for hardware a unique serial or sequence number or for software a unique version letter and date.
Config Verification	The technical reviews and audits necessary to verify that the configuration of parts through systems and CIs comply with configuration identification documentation.
CO	Contracting Officer, who alone can obligate the government and direct change to the contract, including its scope, terms, conditions, etc.
COTR	Contracting Officer's Technical Representative is the technical liaison for the CO, typically develops the Surveillance Plan with Quality Assurance, monitors contract performance and compliance, serves the CO in the review and evaluation of technical documents, advises and provides recommendations to the CO. Any commitment of the government however is reserved exclusively to the CO and must be substantiated in writing by the CO.
COTS	Commercial Off The Shelf is defined to be an item or equipment which was produced using commercial, best practices and processes and can be purchased

	through commercial retail or wholesale distributors as is (for example, equipment that is already produced and available as a catalog item). COTS are sold routinely to a commercial market as opposed to an item produced using military components and standards where typically the military is the Design Agent or controls the configuration of the product(s). COTS is also defined as an item sold in substantial quantities to the general public in the commercial marketplace and which is unmodified by government request, direction or specification. Reference FAR 46.1 and FAR 2.101.
CPR	Corrected Problem Report – see element 25.0.
Critical characteristic	Key characteristic where noncompliance will result in injury, damage to property, loss of life and/or loss of mission.
Critical Item List	A list of items which, because of special engineering or logistic considerations, requires an approved specification to establish technical or inventory control at the component level.
CSCI	Computer Software Configuration Item. See CI above.
CST	Combined System Test – normally flight configuration, engine powered ground test of the flight vehicle with all systems checked internally as well as with ground control and if appropriate other aircraft. Simple Electro-Magnetic measurements are usually taken by a monitoring system also.
DBL	Development Baseline. The initially released documentation describing CI physical and/or functional characteristics that are allocated from those of a higher-level CI, including interface requirements with other CIs, design constraints and the verification required to demonstrate the achievement of applicable functional, physical, and interface characteristics.
DCP	Dryden Center-wide Procedure, NASA/DFRC
Design Agent	Entity responsible for design and configuration control, such as a Software Development Agent.
Deviation	A deviation is a specific authorization, granted through the COTR approved project change control process before the manufacture or test of an item, which is planned or expected to depart from particular requirement(s) of an item's approved configuration for a specific number of units or a specified period of time. See "Major" and "Minor".
DFRC	Dryden Flight Research Center
Discrepancy	See "non-conformance" For the purposes of this document, discrepancies shall be any anomalies, failures, software problems, non-conformances, or non-compliances of any sort.
Discrepancy Report	A problem tracking record for hardware and software; format as specified by the COTR.
DR	Discrepancy Report
EDM	Engineering Development Model is a "prototype" or "breadboard" that closely resembles, but cannot, or is unlikely to, conform to requirements of the final

	product and is not flight worthy. EDM shall not be used for flight or verifying compliance to First Article requirements without prior approval via deviation.
Environmental Test	Reproducible process subjecting a product to those conditions, which it will experience under operational use or storage with some reasonable level of safety margin added. Also see Qualification Test.
Engineering Eval	Sequence of formal or informal steps or procedures conducted by engineering to evaluate technical issue(s), measure against predicted response sufficiently controlled to ensure use in analysis later.
ESD	Electro-Static Discharge
Failure	The event, anomaly, inability or inoperable state of a system, subsystem, component or part does not perform as predicted, specified, or required by released or redlined design documentation under specified conditions for a specified duration..
Failure Modes and Effects Analysis (FMEA)	Analysis of a system and the working interrelationships of its elements to determine ways in which failures can occur (failure modes) and the effects of each potential failure on the system element in which it occurs, on other system elements, and on the mission.
FBL	Functional Baseline. Initial released documentation describing a system or CI functional characteristics and the verification required to demonstrate the achievement of those specified functional characteristics, proven by successfully passing formal test, inspection, demonstration, or analysis. Establishing FBL does not necessarily mean physical attributes have been baselined. This is important to use of ADM (typically lab assets) for formal software tests.
FCA	Functional Configuration Audit ensures that the actual performance of the Configuration Item complies with the requirements stated in the design documentation. The FCA evaluates the test methods, procedures, reports, and other engineering design documentation (e.g., requirements traceability matrix) in support of and including Formal Test(s) used to accept a product.
Findings	A general conclusion derived from the analysis of facts. See FRR.
Flight Worthy	Condition merited by compliance to requirements, construction, environmental and functional tests, verified by formal inspection, demonstration, and/or analysis and validated to meet pilot/operator expectations to be safely used for flight as determined by the COTR.
First Article	First unit produced for full compliance to requirements meeting final intended purposes of the customer, whether a single item from a development environment or a production line. First Article consists of a satisfactorily completed PCA and where functional, Formal Test(s). See EDM and ADM.
Formal Test	Those test readiness reviews and tests using COTR approved test procedures released by the Design Agent's configuration control process where passing is a criteria for determining a product is compliant to acceptance criteria (e.g.

	Environmental, Verification, Validation, Combined Systems Test, etc.) as determined by the COTR and witnessed by the COTR's representative.
FRR	Flight Readiness Review. Investigative process conducted by a Committee or Board of experts, established by NASA/DFRC to assure the project can safely perform flight test or experiment. The FRR experts may also be obliged to report opinion to top management on probability of mission success. The FRR experts ordinarily communicate this information and their conclusion via letter and presentation of Findings, Observations, and Recommendations.
GIDEP	Government Industry Data Exchange Program
Government	United States per law including FARs, encompassing within this SSOR, NASA, CO, COTR, Project, and DFRC Quality Assurance delegated Quality organizations. Does not include the FAA and DERs unless specifically delegated by DFRC Quality Assurance or COTR.
Government Mandatory Inspection Point (GMIP)	A specific step, sequence, or time in a product's life when a NASA mandated product assurance action (e.g., product examination, process witnessing, record review) must be performed by NASA, a delegated Government agency, or by a NASA quality assurance support contractor.
GSE	Ground Servicing Equipment
"Guidance"	Finished products, using documents/standards, etc identified as "guidance", shall be identical to those finished end products that would result if the Supplier had been fully compliant to the requirement, documents, or standards identified as "guidance".
GVT	Ground Vibration Test
HR	Hazard Report
HRT	Hangar Radiation Test – same as CST, but typically without engines and externals, control room or EMI monitoring.
ICD	Interface Control Document
Industrial COTS	COTS product modified or ruggedized to industry or commercial standards for commercial industry market/use. This includes modified COTS products that may conform to military specifications (MIL-SPEC) or may use government standard parts only by coincidence.
Interface	Physical or functional interaction at the boundary between configuration items.
In-process Audit	Inspection of records and/or to observe a Supplier test, demonstration, measurement, or work process to ensure that the process and/or product(s) are being correctly performed in accordance with prescribed procedures and comply with requirements prior to final presentation for acceptance or delivery.
Insight	Surveillance mode requiring the monitoring of end user identified metrics and contracted milestones. Insight is a continuum that can range from low intensity, such as reviewing quarterly reports, to high intensity, such as performing surveys and reviews.

Key Characteristic	Feature(s) of a material, process, or part whose variation has a significant influence on product fit, performance, service life, manufacturability, or with a clear and imminent safety impact if it is not complied with (e.g., output voltage, shields/covers, warning markings, etc.) as determined by the COTR. Key characteristics will be identified and evolved throughout the DFRC project lifecycle. Functional key characteristics are the features of a system, subsystem, or assembly whose attributes are more suitably verified through analysis and/or test.
"May"	Contracting Officer's option unless specified otherwise in contract.
"Major"	Configuration classification applied to change, deviation, waiver, or configuration document, which characterizes the configuration impact on the next using or final assembly as adversely affecting performance, quality, reliability, logistical support, interchangeability, safety, schedule, government cost, increases risk, or modifies the contract in any way. See **Configuration Control** element.
"Minor"	Configuration classification applied to change, deviation, waiver, or configuration document, which has little or no impact on the next using or final assembly as does not adversely affect performance, quality, reliability, logistical support, interchangeability, safety, schedule, government cost, increases risk, or modifies the contract in any way and is not "Major".
Monitor Test	To be present at start of test, but otherwise randomly observe or check an operation to ensure compliance with applicable requirements.
"Must"	See "Shall" per FAR 2.101.
Not for Flight	Product or service, which (1) cannot be integrated into the aircraft or operated during flight; and (2) cannot be used for validation process without prior written COTR informed consent.
Non-Conformance	A condition of any article, material, or service in which one or more characteristics do not conform to requirements. These include failures, discrepancies, defects, and malfunctions.
Observations	A report on something that might not be directly obliged, but is important to comment upon. See FRR.
OEM	Original Equipment Manufacturer
Oversight	Surveillance mode that is in line with the supplier's processes. The COTR retains and may exercise the right to concur or not with the supplier's decisions. Non-concurrence must be resolved before the supplier can proceed. Oversight is a continuum that can range from low intensity, such as customer concurrence in reviews (e.g., PDR, CDR), to high intensity oversight, in which the customer has day-to-day involvement in the supplier's decision making process (e.g., hardware inspections, accepting/passing on hazards, etc).
PBL	Product Baseline. The initial configuration documentation describing the functional and physical characteristics of the product (normally a CI) where the product is compliant to both physical and functional requirements as proven by formal inspection, analysis, demonstration, or test.

PCA	Physical Configuration Audit is the examination of the as-built version of the component against the design documentation defining the component.
PCB	Project Control Board
PDR	Preliminary Design Review, Mandatory Inspection Point for deliverable CIs
Performing Organization	NASA or Supplier entity responsible for executing any contributing work or service (e.g. development, design, manufacturer, fabrication, assembly, test, delivery, etc.). Unless specified otherwise herein, the Supplier.
PID	Product Identification Number
PIDS	Prime Item Development Specification
POC	Point of Contact, person identified by name, complete phone number, email and physical address
Qualification Test	Systematic exposure of a product to an environment beyond its required operational or storage capabilities, which can be, and often is, destructive or causes latent defects. See environmental test.
Quality product	Product which complies with requirements and meets or exceeds customer expectations
RAIF	Research Aircraft Integration Facility, NASA/DFRC
RSSO	Range System Safety Office, NASA/DFRC
RDW	Request for Deviation / Waiver. See Deviation. See Waiver. See Configuration Control.
Recommendations	Per FRR example, an advisory to project or higher organization that in the opinion of the writer(s) will yield positive, significant, results especially to process improvement, flight research, safety, or mission success for the current project being evaluated or other projects. See FRR.
Redesign	A technical change is considered a redesign when the change is such that the resulting product is no longer completely interchangeable with the original design.
Redlines	Modifications to released, configuration controlled documentation sometimes allowed under specific restricted conditions – see **Configuration Control** element.
Reliability	The probability that an item will perform its intended function for a specified interval under stated conditions. The function of an item may be composed of a combination of individual sub-functions to which the top-level reliability value can be apportioned.
Repair	Action(s) restoring a defective product to a COTR approved use-as-is condition, which is not in full compliance with released design documentation, except for properties required for safety and mission success and as authorized by (at a minimum) the responsible Design Engineer and NASA Ops Engineer.
Rework	Action(s) restoring a defective product to full compliance with released design specifications and documentation, as well as conformity to contract requirements.

S&MA	Safety and Mission Assurance, NASA/DFRC
SDP	Software Development Plan, governing Project document
SE&I	Systems Engineering and Integration
"Shall"	Imperative requirement. Compliance is mandatory.
Special process	Is any process that cannot be fully confirmed through immediate testing or inspection so a defect may only surface when the product is being used. Typical examples are welding, painting, and heat treatment of materials. These processes require identification as special processes, clearly defined process parameters, operation by appropriately trained personnel using qualified equipment, and/or continuous monitoring with supporting records.
Surveillance	The continual monitoring and verification of status of an entity and analysis of records to ensure specified requirements are being met. Surveillance activities may be delegated to other parties on behalf of the COTR. It may be 100%, statistically-based sampling, qualitative sampling or the result of discussion with individuals who have first hand knowledge. It also may include the monitoring of contractor supplied metrics, available contractor data, sampling, or surveys.
Software	Computer instructions and computer data definitions enabling the computer hardware to perform computational or control functions.
Specification	A document which describes essential technical and interface requirements for products and the criteria for determining whether those requirements are met.
SRD	System Requirements Document
SRR	System Requirements Review The SRR is used to ensure that the program requirements are properly formulated and correlated with the Agency and mission directives strategic objectives.
SSR	System Safety Review
SSWG	System Safety Working Group, NASA/DFRC governed
Stamp	Ink or mechanical impression which is controlled and traceable to a specific person and when used warrants he/she witnessed or performed the work (task) literally as stated in the procedure, build record, work instruction, report, etc. and the associated data is accurate and complete. Unless the associated statement clearly states acceptance, a stamp does NOT imply acceptance.
STR	System Test Report
System	A composite of equipment, skills, and techniques capable of performing and/or supporting an operational role. A complete system includes all equipment, related facilities, material, software, services, and personnel interfaces required for its operation and support to the degree that it could be considered a self-sufficient item in its intended operational environment.
TIM	Technical Interchange Meetings between Partner(s), Contractor(s), and NASA.

Troubleshooting	A procedure for localizing and diagnosing equipment malfunctions or anomalies, typically by a systematic examination progressing from higher to lower levels of assembly.
Use As Is	A disposition of material with one or more minor non-conformances determined by competent design and quality engineers to be usable for its intended purpose.
V&V	Verification and Validation. Formal test(s) or evaluation/analysis demonstrating system compliance to requirements with acceptable behavior as judged by the final customer (typically NASA's pilot), where the system is an integrated product final flight configuration (including both software and hardware). Types of testing constituting V&V include at a minimum: Software-in-the-loop (SIL) Hardware-in-the-loop (HIL) Iron-bird or airplane-in-the-loop (AIL)
Validation	Proof, by examination of objective evidence, that the product accomplishes the intended purpose. Validation is performed to ensure that the product is ready for a particular use, function, or mission, and may be determined by test, analysis, demonstration, or a combination of these.
Verification	Documented systematic process that objectively proves that the product or system does exactly what it was designed to do and meets each objective requirement of the governing design documentation. Verification is performed to ensure the product complies with requirements and may be determined by test, analysis, demonstration, inspection, similarity, or a combination of these.

Verification Methods are defined as follows:

Analysis	Documented systematic comparison and correlation between design prediction(s), test plans, and results. Analysis shall include verification of unit, subsystem and system performance over expected life and operational conditions. Extrapolations used shall be identified in the analysis document.
Test	Provocation by one or more stimuli and the response of a functioning unit/subsystem/system within specific, controlled, operational conditions. The response is measured and compared to acceptance criteria to verify that unit meets objective (vs. subjective) requirements. To "pass" a test means the response met acceptance criteria. Test procedures shall be documents with sequence of actions/stimuli to perform in order to obtain auditable, repeatable, predicted, results sufficient to determine "pass" conclusion for all allocated requirements.
Inspection	A method of physical examination of document, unit, subsystem, or system and comparison to drawings, specifications, configuration documentation, process or measurement standard. Inspection is not analysis in that there is no attempt to evaluate test data. Inspection is typically used to verify requirements relative to physical

characteristics (e.g. construction features, finish, identification marking, cleanliness, etc.) Inspection of a test report can be used to conclude compliance to applicable functional requirements.

Demonstration — Functional evidence or proof that allows no doubt as to compliance with predicted outcome, commonly using replacement or simulation of component (software, wind tunnel, system interface device, breakout box, etc.). The item is therefore not tested but demonstrated in that the configuration integrity is to some degree "compromised" in an acceptable manner. For example, an electrically identical system interface device (SID) could replace an igniter to protect personnel conducting functional operational checkout of a missile's flight termination system prior to launch. Operation of the circuit does not result in destruction of the missile.

Similarity — Assessment method comparing a component, unit, subsystem, or system using compliance documentation (test report, configuration documentation, inspection reports, etc.) and analysis for non-identical aspects to determine the suitability of another component, unit, subsystem, or system that has already been qualified to equivalent or more stringent criteria. Differences in configuration, application, or test conditions usually require analyses and additional testing to complete verification by method of similarity.

VDD — Version Description Document

Waiver — Unplanned variance from design documentation or specification and written authorization to accept an item, after manufacture, or after being submitted for Government inspection or acceptance, that is found to depart from specified requirement(s), but nevertheless is considered suitable for use "as is" or after repair by an approved method. Waiver is granted for a specific number of units or a specified period of time

WATR — Western Aeronautical Test Range

"Will" — Identical as "Shall" for requirements.

Witness — Competent observer present from start to finish of test or operation to assure compliance with requirements, typically inspection or test operation.

WO — Work Order

2.0 Applicable Documents

The SOFIA Platform Project expects the suppliers to comply with the following or equivalent. It is the Supplier's responsibility to secure clarification for any issues in these documents.

2.1 *NASA Specifications and Standards.*

Number	Date	Title
DCP-O-018	21 Apr 02	XNET BASED Dryden Centerwide Procedure, Code O, Environmental Acceptance Testing Electronic and Electromechanical Equipment.
DCP-O-005C	18 Aug 05	Parts Control Tag

DCP-S-006A-1	2 Jul 07	Quality Assurance Audit
DCP-S-007B	6 Dec 02	Software Assurance
SOFAP-DRC-00001-CMP-REV-		SOFIA Platform Project Configuration Management Plan
SOF-1054 Rev 3		SOFIA Program Configuration Management Plan
APP-DF-PLA-PM20-2000	30 Nov 07	SOFIA Platform Project Software Development Plan
APP-DF-PLA-PM20-2002	30 Nov 07	MCCS Software Development Plan
APP-DF-PLA-PM20-2003	30 Nov 07	SOFIA MCCS Software Assurance Plan
SOF-1068	4 Apr 08	SOFIA Program Risk Management Plan
SOF-1086	4 Feb 08	SOFIA Program Safety & Mission Assurance Plan
APP-DF-PLA-PM21-2000	7 Feb 08	SOFIA Airborne Platform Quality Assurance Plan
SEMP rev A	6 Sep 07	Systems Engineering Management Plan

2.2 *Other Specifications and Standards Documents.*

Number	Date	Title
MIL-STD-129M	10 Sep 07	Marking for Shipment and Storage
MIL-STD-130N	17 Dec 07	Identification Marking of US Military Property
AS9100B	1 Jan 04	Quality Management Systems - Aerospace - Requirements
AS9102	1 Jan 04	Aerospace First Article Inspection Requirements

3.0 Access, Site and Other Privileges

Supplier access and system privileges will be negotiated under the NASA SOFIA Platform Project.

Useful websites:

www.nasa.gov/centers/dryden/home/index.html

www.nasa.gov/centers/ames/home/index.html

www.edwards.af.mil

www.nasa.gov/centers/dryden/site9/

4.0 Quality Management System

The Supplier shall develop, document, implement and maintain a quality management system that complies with AS9100 REV B and covers all facilities and organizations involved in contract execution.

5.0 Configuration Control

Configuration Control shall be in accordance with the SOFIA CMP: SOFAP-DRC-00001-CMP.

Unless specified otherwise in the contract, the entity that designs the product shall be the Design Agent responsible for configuration control of the products and services.

The Supplier shall identify a configuration control board Point of Contact (CCB POC).

Where the Supplier is not the Design Agent and change is required, the Supplier shall submit a written change request to the COTR. Resulting discussion, change, and revision shall be coordinated between the Supplier CCB POC and the COTR.

Where responsible for configuration control in whole or in part, the Supplier shall: provide copy of Supplier's Configuration Management Plan (CMP) with sufficient detail to ensure compliance to contract and requirements of this SSOR; and expeditiously coordinate efforts between Supplier's CCB and SOFIA Platform Project's PCB. If the Supplier's CMP is approved, the CO may

delegate to the Supplier the authority to provide local configuration management and control over minor changes, which do not adversely affect NASA or other organizations, project cost, contract milestones/schedules, overall project/system risk or contract scope or obligations. The COTR will participate in the Supplier CCB as required. The COTR shall identify the PCB POC(s).

A unique version number shall be assigned to each hardware and software revision. The version-numbering scheme shall be defined in a document available to the COTR - ideally in the CMP or for software, the Software Development Plan (SDP).

Major changes and Request for Deviation/Waivers (RDWs) must clearly be identified as "Major" and require informed COTR consent (written approval) before implementation/execution. Major changes involving increased cost will be treated as proposals that shall comply with applicable sections of the FARs, notably 52.215-219. The Supplier shall provide reproducible copy of minor changes and RDWs to assure concurrence with "minor" disposition. Minor changes shall not increase government cost or authorize change to contract or requirements. Upon receipt, the COTR has ten (10) working days to review Supplier material, unless mutually agreement between COTR and Supplier for more time due to size or scope of Supplier material. If not informed otherwise in writing, after review time has passed, a lack of response results in automatic concurrence.

5.1 *Common or Limited Access Website*

The Supplier is encouraged to discuss use of common website(s) with the COTR. In the event a common website is used, access shall be mutually controlled as determined by the COTR and Supplier. The IT Security Plan will cover specifics of the agreed upon terms. Access privileges shall be revoked upon leaving the project. Password access, effective virus protection measures, personnel access, read/write authority, naming conventions, organization/structure, and configuration control measures shall be established and agreed upon prior to loading the website with any data, documents, files, etc. NASA and government authorities shall have access to government-funded project related products (e.g. test data, failure data, software, etc.) on websites, on a need to know basis as determined by the COTR.

5.2 *Redlines*

Modifications outside of the process governed by the approved CMP are not allowed. In the event of error discovered in the design documentation for fabrication, test, verification, validation, etc., the responsible design engineer may (if allowed by the CMP) make redline changes to complete test or process under way provided there are clear configuration control measures - typically this includes three things: (1) concurrence written or verbally to the test conductor from approvers of the design document; (2) signature, stamp or initials - with date by the responsible design engineer next to the redline; (3) formal change to the original document if there is to be any subsequent use of that document; and (4) redline changes immediately sent upon concluding operation to the CCB for record of change if not incorporated into new released revision of all affected documents.

In the event redline(s) are made to affecting operations (e.g. measurements, tests, analysis, verifications, test procedure, etc.): (a) Government representatives shall be provided reproducible copy of any redlines they observe, witness or monitor and; (b) copy of each change used to accept product will be associated with test data submitted to the COTR.

5.3 *Supplier Developed/Controlled Software*

The Supplier shall ensure that each software version is stored on a read-only media. This will include the executable, source code, and any required makefiles, project files, scripts, etc. It shall include change description ideally as an electronic copy of the Version Description Document.

The Supplier shall be responsible for generating the software test plan(s), reviewing the test procedures, monitoring the tests, and conducting the post-test data reviews. The Supplier's CCB POC will be a required signatory on the final test reports and the Software Media Release forms, which will be required before any software is loaded in the flight test vehicle.

Each CSCI version shall have a unique identifier before being loaded into the flight test vehicle.

Any discrepancies with the software and corresponding solutions will be tracked, and status made available to the COTR's representative(s) via Discrepancy Reports (DRs) and/or Problem Report system.

Software requirements shall be configuration controlled and tracked throughout the life of the Project.

Each and all Computer Software Configuration Item (CSCI) covered under this SSOR fall under the following three categories:

1) Direct Control: CSCIs which are developed and whose configuration is controlled entirely by NASA/DFRC within the scope of the PCB. Software change requests can be originated, implemented, and closed entirely within the PCB process.

2) Indirect Control: CSCIs whose requirements and/or specifications originate within the NASA/DFRC project, but which have code developed and controlled by outside organizations, such as the Supplier. Software change requests must be coordinated with the other CCBs for implementation.

3) Insight Only: CSCIs reviewed by the COTR's representative(s) to ensure safety or mission success, but not controlled from within the NASA/DFRC project. Although the COTR may request software changes, all change requests are opened, implemented, and closed outside the direct control of NASA/DFRC configuration control processes.

Each CSCI shall be put under configuration control before any formal test is performed.

If functional baseline is established, each proposed change shall include description of regression testing required to re-verify/validate the CSCI and shall be closed only with successful completion of that testing and written report stating product has passed the tests.

CSCIs under the "Indirect Control" category are those for which specifications, requirements, and change requests are controlled within the NASA/DFRC project, but actual coding is performed elsewhere (outside the Project). The configuration of these CSCIs will be controlled via the following guidelines:

Any software developed at NASA/DFRC and provided to the Supplier will be considered an Indirect Control CSCI. This software will be developed using NASA/DFRC processes and standards. The software, source code, Software Development File, and Version Development Description will be released to the Supplier once development is complete and is ready for formal verification and validation testing. At this point, ordinarily the software will be submitted to the Supplier for configuration control under Supplier processes, but remains the property of NASA/DFRC and cannot be used, sold or modified without the CO's informed written consent.

The DFRC Project Software Manager will retain a copy of the source code, executable, and all required makefiles, project files, etc. on read-only media.

5.4 *Design Agent Responsibilities*

Unless specified otherwise by the contract, the Design Agent shall be responsible for design, development, and configuration control (to include internal release and control systems) for all delivered services, data, documentation, hardware, firmware, and software products over the duration of the Program/Project. The Design Agent shall provide product configuration identification and control documentation that will establish the product baseline at the end of the design and development phase(s). The Design Agent shall control design requirements starting with the Preliminary Design Review (PDR).

The Supplier shall track and implement effective immediate corrective action for each problem reported to assure that safety is not compromised, costs are minimized and no defective or suspect product is delivered to NASA. In cases where corrective action does not appear to be practical, possible or reasonable, the NASA COTR and Quality Assurance representative shall be consulted before final resolution through the COTR. The Supplier shall report problems affecting safety (e.g. potential failure during flight operations) to the NASA Safety & Mission Assurance Representative and COTR within 24 hours of discovery.

5.5 *Substitute Parts.*

Parts may be substituted only if sanctioned as alternate parts by released drawings or the COTR approved Supplier CMP, or by specific COTR approval via RDW (reference DCP-O-001).

5.6 *Configuration Baseline*

The governing CCB shall identify all approved documents that represent the definition of the product at a specific point, called the configuration baseline. See **In-Process Audit** element.

5.7 *Development Baseline (DBL)*

The DBL shall be established by the completion of a Critical Design Review (CDR). The COTR shall be informed and provided written updates including rationale with cost/savings and schedule impact for design, for departures from the CDR. Note that this is ideally accomplished through clear visibility in a properly functioning CCB change document process, but may be effected by other means acceptable to COTR and Supplier.

5.8 *Functional Baseline (FBL)*

The FBL shall be established by passing a formal test of the product for the first time.

5.9 *Physical Configuration Audit (PCA) Baseline*

A PCA baseline shall be established when all physical aspects of the deliverable product are reflected without unauthorized departure in configuration controlled, released, design documentation. In addition, manufacturing processes, governing control documentation, materials shall be predictably controlled and personnel trained sufficiently to produce exact replicas if necessary.

5.10 *Product Baseline (PBL)*

A product baseline is established by completing FCA, PCA, qualification testing (if applicable), and formal test at the deliverable product level with closure of all open product related action items to the mutual satisfaction of COTR and Supplier.

5.11 *Flight Test – Software Loads*

NASA/DFRC Operations Engineering must approve any software installation involving the flight test vehicle and associated procedures performed at NASA/DFRC. Part of the acceptance criteria for these procedures shall include positive verification by NASA Quality Assurance/SQA that the correct software versions are installed on the Aircraft and that they cannot be changed by simply power down and back up, or aircraft functions for flight test operations. Ref: APP-DF-PLA-PM20-2003.

5.12 *Insight Only - Software Changes*

By definition, the COTR has no control over CSCIs in the Insight Only category. Requests for changes will be submitted using the processes of the governing CCB. Discrepancies for delivered products will be opened and tracked in the NASA/DFRC CCB process, but they will be submitted to the governing CCB for resolution. Ref: APP-DF-PLA-PM20-2003.

5.13 *Documentation – Generic Requirements*

Each deliverable product document shall include at a minimum:

Title sheet:	Description title, unique document number (including serial number if applicable), revision, date, originator name(s), organization or company name and if prepared using any government funds, the contract number.
Remaining sheets:	Each sheet - page number and revision or date

6.0 Data Analysis Plan (DAP)

The Supplier is not required to provide a DAP unless directed otherwise by the contract. If the contract directs delivery of a DAP, the DAP shall be submitted by the requesting client for approval by the Project through the change control board. The Supplier may originate a Data Analysis Plan for gathering data important to the Supplier's products and be identified as the client for that data, but the Project reserves the right to assure risk, schedule and cost are acceptable in its accept/reject decision. A very simple DAP is provided in Appendix A.

7.0 Receiving Inspection

Piece parts and materials (e.g. fasteners, wire terminators, raw metal billets, etc.) will be inspected / tested per the Supplier's receiving organization's sampling plan or processes. No statistical sampling is required unless with CO's concurrence there are sufficient quantities to institute statistically significant sampling.

8.0 Metrology, Calibrated Equipment/Tools

Control of monitoring and measuring devices used to perform product assurance actions shall comply with the requirements of AS9100 rev B section 7.6

All hardware inspection, measurement, test-and-checkout operations that are performed against acceptance criteria shall be performed using calibrated equipment.

8.1 *Recording of Calibrated Item On-Aircraft.*

Note: The aircraft workbook procedure currently has a requirement for recording the usage of torque wrench calibrated equipment.

Usage of any calibrated items (mechanical, electrical, etc.) to satisfy requirements shall be recorded in the "Work Items Results" block of the work order. Usage of any calibrated items (mechanical, electrical, etc.) to satisfy requirements shall be recorded where practical in the aircraft workbook or NALCOMIS.

9.0 Government Mandatory Inspection Points (GMIP)

NASA Project Quality Assurance will establish, for the purpose of assuring product quality, reducing risk and costs to the Supplier and NASA, Government Mandatory Inspection Points (GMIP), Surveillance Activities, Quality System Evaluations (Audits), and Final Acceptance of Hardware. The Supplier shall immediately notify the COTR and DFRC Quality Assurance if these efforts compromise final product.

- Product Examination: products shall be physically inspected, measured, or tested to ensure conformity to requirements.
- Process Evaluation: processes for manufacturing, fabrication, assembly, integration, test, and inspection shall be physically witnessed to ensure compliance with requirements.
- Record Review: records evidencing conformance to requirements shall be reviewed to ensure product and process conformance to contract requirements.
- Risk Mitigation Actions: derived from project risk analyses (e.g. probabilistic risk assessments, hazard assessments, hazard analyses, failure modes and effects analysis/critical item list.)

Government Mandatory Inspection Points including product examination, process evaluation and records review may, at the government's option, be performed on key characteristics selected by the COTR, typically starting with the Critical Design Review (CDR) or as determined otherwise by the DFRC Quality Assurance Representative.

GMIP shall be performed to ensure 100 percent compliance with safety/mission critical attributes. Safety/mission critical attributes include hardware characteristics, manufacturing process requirements, operating conditions, and functional performance criteria that, if not met, can result in loss of life or loss of mission. GMIPs will also include the incorporation of risk mitigation actions derived from project risk analyses (e.g. probabilistic risk assessments, hazard assessments, hazard analyses, failure modes and effects analysis/critical item list) performed by COTR, DFRC Quality Assurance, and/or Supplier.

Safety/mission critical GMIPs shall not be waived nor GMIP criteria modified, except as formally authorized by proper NASA authority.

Performance of GMIPs shall be as late as practicable in the material fabrication/installation cycle for circumstances where GMIP attributes can be altered and as early as practical for attributes that cannot be altered.

10.0 Tracking Obsolescent Parts

The tracking of obsolescent parts is not required unless directed otherwise by the Contract.

The Supplier shall immediately inform the COTR in writing of known parts that have become or on a specific date shall become obsolete. The Supplier shall include with this notification, recommendation(s) for action(s) and other pertinent information, such as alternate parts, better design/logistical solutions, costs, procurement contacts, etc.

11.0 Government Industry Data Exchange Program & NASA Advisories

Unless directed by the contract otherwise, the Supplier is encouraged to review applicable GIDEP documents (Alerts, SAFE-Alerts, Problem Advisories, Agency Action Notices, and Diminishing Manufacturing Sources and Material Shortage, as necessary) and NASA Advisories to determine applicability to Project products/hardware/software. Specific requirements of the GIDEP S0300-BT-PRO-010 and S0300-BU-GYD-010, are available from the GIDEP Operations Center, P.O. Box 8000, Corona, California 91718-8000.

12.0 Limited Life Items

The Supplier shall identify to the COTR and track Limited Life Items for design, development, and operation phases of flight hardware and Ground Support Equipment. Limited Life Items are those items identified in the contract that are designated as having a limited useful life regardless of limited operating life, limited shelf life, operating life sensitive or a combination of these.

13.0 Lifetime Test

Product lifetime tests are not required unless directed otherwise by the Contract..

Lifetime test shall be defined to be a test that under mutual agreement of the COTR and Supplier and can be used to establish the likely failure age of products tested. When contract directed, the Supplier shall provide a test plan and test procedure for approval by the COTR. Approval from the COTR in writing is required prior to initiating test.

14.0 Records, Data Management

Manufacturing, assembly, test and checkout operations, functional test, corrective actions, and acceptance test shall be documented as required by AS9100 REV B or equivalent method. Records shall be established and maintained to provide evidence of conformity to requirements and the effective operation of the quality management system. Records shall be legible, readily identifiable, and retrievable. The COTR and DFRC Quality Assurance reserve the right to periodically review (and copy) all records and data in connection with products or services contracted. This shall include, but is not limited to, inspection, test procedures, test results/reports, discrepancy reports, corrected problem reports, hazards, risks, purchase order/subcontract documentation, including electronically generated and maintained records on an approved database, within the Supplier's quality system. Record retention duration shall be set by the contract. Contact the COTR if not clear.

14.1 *Proprietary/Sensitive/Classified Information/Products*

(Reference FAR 52.227-14 alternate II, as modified by 1852.227-14) The Supplier shall immediately, when conceptually planned or known, provide written notification to the CO with specific, comprehensive, description and rationale for the use and application of sensitive, classified and proprietary information/product(s). "Specifics" here means declaration of classified material, or evidence substantiating the sensitive or Proprietary claim. The Supplier shall provide unambiguous, written justification for any claim to sensitive or proprietary rights sufficient for the

COTR to subsequently recognize and identify the claim, especially in design and development activities.

The government cannot and shall not treat nonproprietary information/products as proprietary. The CO and Supplier shall agree in writing to proprietary claims before executing design or development or modification activities and before declaring or marking any proposed design information/product(s) as proprietary.

Supplier proprietary claims (e.g. briefings, design documents, hardware and software) by marking as proprietary shall be solely at the Supplier's expense, including the cost of the government to confirm the claim where rationale does not support the claim. The Supplier is solely responsible to identify, mark, package, and securely deliver proprietary items to assure inadvertent disclosure.

See **Marking, 24.0 Proprietary Marking**.

14.2 *Data Management*

Data is defined here to include measurements, sensor input, test results/information, inspection products, documentation, electronic or hardcopy. This includes all formal aspects of the project, including and not limited to simulation used for predicting results, ground and flight operations.

Data collectors (those persons, agencies, or firms who collect data) at the time of test shall determine that data is being properly collected and further that data is reliable, not corrupted or missing. Data integrity shall be verified during formal test when possible to assure hardware/software and the supporting systems are sound and products are accurate, complete, and reliable. The absence of confirmed reliable data constitutes a No-Go for data collection. Each data collector must provide phone number, email address and physical address for a single point of contact and alternate to the COTR.

Unless otherwise agreed, each data collector will process and deliver two (2) copies of data to the COTR within two (2) working days of collection. Anomalies, media defects and missing data must be identified to the COTR before delivery.

The data collector shall store test data and assure its availability to the COTR for the duration of the Project plus one year or until such time that the COTR has determined that the COTR has successfully received acceptable, uncorrupted data and relieved the data collector of obligation to store data. From that time forward the COTR shall be responsible for the maintenance and further dissemination of data. Raw data shall be recorded, stored, and transferred to the COTR by data collector separate from any converted data, unless agreed otherwise by the COTR.

Format and media shall be determined between COTR and Supplier, default otherwise being:

Data media: CD or DVD

Data format: preferred – tab delimited; alternate - space delimited ASC II text

Video: DVD

Electronically transferred data shall be in a format that can be communicated, transferred to and used by the COTR for subsequent control, storage, retrieval and dissemination to responsible data analysis engineer(s).

The data collector shall ship media to the COTR per contract instructions.

Neither data nor analysis may be copied, transferred or otherwise provided to any person or entity without the written approval of the COTR. While methods of collecting data may be proprietary, the data itself shall not be proprietary unless agreed to in writing by the COTR and marked per element 24.0.

14.3 *Engineering Data Package*

The Supplier shall provide the Project with schematics, mechanical design, and software documentation and code sufficient to identify mounting/installation, interface connections and programming of the product by the COTR and/or technology partners/contractors. If government funds are used to update existing, or develop new drawings, parts lists, software or firmware, then the Supplier shall ensure that all said engineering documentation is provided to NASA/DFRC per contract.

A. **Drawings**. Drawings will be in accordance with ANSI Y14 series or COTR accepted format. Drawing(s) shall include outline and installation/mounting (O/I) drawings, with identification of all mating connectors, product dedicated switches, adjustment controls, pin out identification (e.g. 28VDC power, GND, chassis GND, etc.), required mounting hardware and Notes sufficient to identify any handling, adjustment, calibration, service and/or care instructions.

B. **Schematics/Software documentation**. The Supplier shall provide sufficient information for NASA/DFRC or its contractor(s) and technology partner(s) to develop input/output, displays, command/control logic and interfaces between each product and flight test vehicle systems. Software documentation should define the exact contents and status of a software Configuration Item as well as procedures on how to build and distribute the software.

14.4 *Manufacturing Data Package*

Unless specified otherwise in Contract, where the government has provided funds for design, the Supplier shall deliver reproducible hardcopy and electronic media acceptable to the COTR. The data package shall be a complete drawing package compliant with MIL-STD-100 (and items A. and B. above) and containing sufficient detail (e.g. identify sources of supply, dimensional information, etc.) for a third party to re-produce the item being described. NASA retains the right to manufacture the product, in part or in total for NASA or all other government entities without royalty or other encumbrances.

15.0 Environmental Requirements

Products already compliant with DOD or FAA Part 25 requirements need not be retested to these requirements so long as they comply with DCP-O-018, Category II or the COTR has cleared the product test as acceptable in writing as is.

This element contains default requirements. Environmental requirements vary depending upon variables such as planned current and future use, altitude, thermal considerations, vibration of mounting surfaces, etc. The application of appropriate requirements involves related issues such as the potential for rapid decompression, EMI integrity, single or multiple uses, open canopy during rain, hot cockpit with all access closed, location within the aircraft, etc. If environmental requirements are absent in the contract, the Supplier shall immediately write the COTR to resolve.

Each flight worthy product, including each spare, shall be tested and demonstrated to be compliant to the environmental requirements. Otherwise, each product shall not suffer damage, deterioration, or degradation of performance, because of test nor when subjected to any environment or combination of environments specified in the contract. If such deficiency is anticipated, the Supplier shall immediately notify the COTR in writing to discuss the issue further and resolve before destroying product(s). Any product that has been destroyed or suspect or degraded to the point where it cannot meet requirements in the process of environmental test shall be marked as NOT FOR FLIGHT in accordance with requirements of **Marking** element 24.0.

The CO and Supplier may mutually agree to postpone environmental test(s) until after delivery or submit the products to alternative tests (e.g. CST by NASA instead of EMI lab tests) or analysis report rather than rapid decompression or destructive test, etc. Such agreement does not relieve the Supplier of meeting requirements. Acceptance and even payment for product does not constitute final acceptance or relief to the Supplier of any or all obligations.

15.1 *Qualification Units*

Qualification items shall be identical to the product(s) to be delivered. Qualification units may be tested to destructive levels as dictated by the contract. Once Qualification tests are completed, the Qualification unit(s) shall be permanently marked as "QUAL UNIT" and if degraded marked NOT FOR FLIGHT per **Marking** element.

16.0 Electro-Static Discharge (ESD)

The Supplier shall document and implement an electrostatic discharge (ESD) control program in accordance with ANSI/ESD S20.20, ESD Association Standard for the Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices). Parts must be properly packaged and identified as required in ANSI/ESD S20.20.

Those products containing devices sensitive to ESD shall be marked per **Marking** element. The Supplier shall ensure that products and parts, which are ESD sensitive are protected from damage through all aspects of the processes necessary to deliver the product(s), from procurement through final delivery, including any follow up work subsequent to delivery. Compromised products shall be identified to the COTR and dispositioned as nonconformances, prior to delivery to the Project. Without mutual disposition to proceed, the Supplier proceeds at solely the Supplier's risk.

17.0 Hazardous, Explosive, Combustible Materials/Fuels

The Supplier shall ensure that any products with explosive or combustion materials are properly transported, stored, marked, packaged, handled, etc. in accordance with all applicable laws and guidelines. In addition, the Supplier shall identify the material and any potential hazard and/or safety related issue to the COTR in writing at least 10 working days prior to delivery. This shall include, but is not limited to, MSDS. For example, touching a mirror surface or high intensity light bulb with bare hands could degrade its performance and useful life span. In addition handling of the light bulb might result in implosion. In such cases, the Supplier shall identify these types of issues to the COTR beginning with the design reviews. Also see Personnel Protection Equipment.

18.0 Flight Termination System (FTS)

Not applicable unless specified otherwise in the contract. Where applicable to the contract, the FTS work shall be coordinated with the NASA Project Lead FTS Engineer and DFRC Quality

Assurance through the COTR. Closeout photos, special inspections, and obligations will be required. See the Contract SOW for further details/requirements.

19.0 Flight Worthiness

See contract for roles and responsibilities, which may be different from the requirements of this element.

The Supplier shall support Flight Readiness Review (FRR) activities, and provide information to the COTR as may be needed. (This often is expedited with little or no impact to Supplier or project by simply providing the FRR members with information readily available via access to a common website or documentation/record library.)

Each flight worthy product must securely fit into the aircraft without interference or potential damage to surrounding, interfacing equipment or hazard to the operators. The Supplier shall work with the COTR to assure that no Supplier product prevents or degrades rapid egress or emergency ejection, nor shall any product project beyond the plane defined by neighboring displays if installed into the aircraft cockpit.

The installed Supplier product(s) shall not damage or degrade performance of the aircraft and its systems. Further, The Supplier shall provide the COTR with evidence of compliant flight worthiness of deliverable product(s) prior to acceptance of product(s) by the government. Evidence shall consist of:

A. In-process inspection with COTR and DFRC Quality Assurance prior to sealing and testing unit(s);

B. Supplier's written certification as to environmental compliance, confirming there is no use of toxic, carcinogenic or flammable materials and flight worthy acceptance by FAA or DOD or NASA for this or related "sister" product(s).

Typically while ground test units (not for flight) must be functionally identical, they need not be compliant with the above. However see **Software** element for specifics relative to test using such ground support equipment.

Wiring. Polyvinyl Chloride (PVC) insulated wire shall not be used. Nor shall flammable insulation be used without RDW approved by the Project.

Mercury. Given the potential destructive properties of mercury and its hazardous effects on people, product shall not be delivered with mercury in liquid or gaseous form.

Hazardous, Toxic Materials. The Supplier shall immediately identify all toxic materials and hazards in products when discovered. For example, otherwise safe batteries under routine charging operations can emit lithium or hydrogen gas that is dangerous to personnel.

20.0 Government Furnished Equip/Property/Info (GFE/GFP/GFI)

See contract, Section G and I.

21.0 Generic Design Requirements

The Supplier shall prepare design review materials for each product designed under contract.

21.1 *Preliminary Design Review (PDR)*

This is a formal technical review of the basic design approach for a configuration item or for a functionally related group of configuration items (hardware/software or both). The PDR demonstrates that the preliminary design meets all the system requirements with acceptable risk and within the cost and schedule constraints. The PDR also establishes the basis for proceeding with the detailed design. It will show that the correct design options have been selected, interfaces have been properly allocated, and verification methods have been described.

This review is conducted by the Design Agent with the participation of both Supplier and COTR's representatives for each configuration item or grouping of configuration items to: (1) evaluate the progress, technical adequacy, and risk resolution (on a technical, cost, schedule and safety basis) of the selected design approach; (2) determine compatibility, compliance with performance and engineering specialty requirements of the hardware and software configuration items specifications; (3) evaluate the degree of definition and assess the technical risk associated with other processes (e.g., building components, subsystems, etc., use of exotic materials, simulation, etc.), and (4) establish the existence and compatibility of the physical and functional interfaces among the configuration items and other items of equipment, facilities, software and personnel.

For Software configuration items, the PDR will focus on: (1) the evaluation of the progress, consistency and technical adequacy of the selected top-level design and test approach; (2) compatibility between software requirements and preliminary design, and (3) on the preliminary version of the support documents. The PDR demonstrates readiness to enter the final design phase culminating with a Critical Design Review. The PDR may not be a single review. It can be a number of reviews that includes the system PDR and PDRs conducted on specific Configuration Items. This differs from delta reviews, which are held because the original PDR may not have met all of the required entrance criteria or requirements have changed.

The Supplier shall invite the COTR (and COTR identified representatives) to the PDR.

The PDR entry and exit criteria are:

- PDR Level Entry Criteria:
  - Preliminary or released or detailed approach available for Quality Assurance, Configuration Management, Reliability Maintainability, Risk, Safety/Mission Assurance, and Hazard Analysis.
  - Preliminary design specifications
  - Preliminary software architecture
  - Risk assessment and mitigation
  - ROM Cost and schedule estimates
  - Preliminary safety analyses
  - List of drawings with title
  - Interface control documents
  - Preliminary verification/validation approach
- PDR Level Exit Criteria

- Preliminary design meets requirements with acceptable level of risk
- Requirements flow down is complete or, if not, plan exists for resolving open items
- Design can be fabricated, long lead items identified
- Interfaces are defined and consistent
- Adequate technical margins exist
- Any required new technology development identified
- Key and critical characteristics, tests approach and special inspections/measurements are identified relative to emerging technology, new or difficult/risky fabrication processes, or hidden during assembly
- Human factors have been addressed where required
- Project risks are understood and mitigation plans developed
- Safety and mission assurance considered

Within 7 calendar days of concluding the PDR, the Supplier shall ensure that minutes of the meeting are published and distributed (or made available in a Program/Project accessible website). The minutes shall contain at least the presentations, documentation of any decisions made, attendance list, and action items (with responsible assignee and dates to be closed). Meeting the exit criteria and closure of action items to the satisfaction of the Project will establish the "design-to" baseline and allow the Supplier to precede to final design.

The PDR shall address design features (e.g. electrical, mechanical, functional, thermal, software, etc.), the above items, as well as:

- Status of completion/closure of all action items from prior events such as (System Requirements Review, Requirements changes, etc.)
- Interface physical and functional requirements and interface control data (e.g., interface control drawings), including interface signal identification/assignments,
- Ensure that all system requirements have been allocated; proposed design complies with all contract requirements; the flowdown is adequate to verify system performance
- Any necessary departures anticipated and desired alternate or tailored requirements are identified
- Preliminary Mass properties aspects (weight, center of gravity, etc.)
- Environmental compliance, corrosion and thermal design aspects
- Power distribution and grounding design aspects
- Key and critical (safety and programmatic) characteristics with recommended Mandatory Inspection Points
- Approach to determine instrumentation requirements, sensor selection, installation for flight test and environmental tests (See Data Instrumentation.)

- Design safety issues, hazards and risks have been identified, characterized and mitigated, where appropriate, this includes identification of stored energy devices (e.g. mechanical springs capable or causing injury, batteries, pressure tanks, high voltage capacitors, etc.)
- Potential safety training, special processes, or personnel protection equipment that may be required for NASA personnel in connection with the proposed design
- Transportability, packaging and handling considerations
- Human engineering and Biomedical considerations
- FTS (if one exists);
- Spares approach;
- Results of trade studies and design studies;
- Competent staffing levels (with any critical individuals identified by name)
- NASA personnel special training required by Supplier (e.g. ESD, facility protocol, design software applications, etc.);
- Identification of any flight qualified, prototype, or lab products already procured or developed (e.g. qty, description, part number, serial number, performance specification, interface details (physical, datalink protocols), functionality at time of PDR)
- Identify new or emerging technologies that will be part of the proposed design.
- Brief description of capability, facilities where work will be performed with required access necessities/limitations, facilities, website, drawings, documents, meetings, technical briefings, safety briefings
- Software functional flow incorporating all of the requirements
- Software resources required (e.g., personnel, facilities, tools, equipment, etc.)
- Software controls
- Software structure
- Software security
- Software updates from last review to any delivered/baselined software
- Identify any support equipment that will be developed or required
- Simulation verification/validation approach
- Mock-ups, models, breadboards, or prototype hardware, when appropriate
- Proposed test approach to fully leverage Contractor and Government assets, including any departures, suggested improvements from what may have already been proposed
- Clear unambiguous statement on what will and will not be proprietary information as complete and agreed upon with COTR; Security and data restriction considerations (ITAR, proprietary, etc.); existing documentation (e.g., commercial manuals for any COTS items, aircraft manuals, etc.) that will be used. See proprietary requirements, element 14.1.
- Schedule

- Cost Analysis/Life Cycle Cost Analysis updates
- Risks and all problems related to providing a high quality product on schedule.

The Supplier shall provide sufficient detail and design documentation to communicate how proposed design shall meet or exceed objectives and requirements. In this regard, the Supplier is encouraged to send before the review whatever might expedite the process (e.g. PDR slide package available on COTR accessible website; plans, procedures, specifications, drawings, etc.)

The PDR shall have available for review the following list. The list may be tailorable through the COTR, but if an item is tailored out, the reasons for doing so shall be presented at the PDR.

1. Preliminary Software Test Plans
2. Preliminary Hardware Test Plans
3. Preliminary versions of the simulation plans
4. Preliminary drawings
5. A review copy of PDR presentation documentation should be available to all PDR participants at least one week ahead of the scheduled PDR to allow enough time for the participants to review the materials and make the meeting productive.

21.2 *Critical Design Review (CDR)*

CDR demonstrates that the maturity of the design is appropriate to support proceeding with full-scale fabrication, assembly, integration, and test. CDR determines that the technical effort is on track to complete the flight and ground system development and that mission operations will meet mission performance requirements within the identified cost and schedule constraints.

The CDR shall be the same as PDR above, with the following additional requirements and modifications.

The Supplier shall include Delta CDR/PDR slide(s) to describe any variances in design or design approach taken since PDR.

The Supplier shall status/brief at a minimum: Staff losses/gains; CCB status (e.g. list of released documents, membership, subcontractor and Project CCB relationships); simulation efforts and results to date (particularly interested here in Project/Supplier simulation roles and responsibilities, coordinated efforts and problems such as data format/conversion); Control laws/issues; software (including classification, dead code, automated test(s), neural network, problems, tracking system performance, verification and validation strategy); new or emerging technology issues/alternatives; structures/loads analysis, predictions and data; environmental test plans (simply what will be tested, who tests, where, when, and qualification units, destructive/degrading tests anticipated); Flight Readiness Review (FRR) discussion; PDR action item list status; test strategy; test strategy and status; recommendations for improvements; parts derating; GFE/GFP (e.g. pending maintenance, calibration, certifications, unmet needs/expectations, etc.); subcontractor performance/compliance; In-Process Audits strategy (typically none conducted before CDR); and problems encountered since PDR or anticipated before delivery.

The Supplier shall identify what, if anything, the Supplier needs from the Project or the Project's technology partners (e.g. test equipment, technical support, information, facility use, etc.), the duration of need and benefit(s) to the Project in providing for those needs. Benefits shall address both cost savings to the Project and schedule improvement.

The CDR entry and exit criteria are as follows:

- CDR Level Entry Criteria
  - Build-to specifications
  - Fabrication, assembly, integration, and test plans and procedures
  - Technical data package
  - Schematics, spares list, ICDs, analyses
  - Software design documents
  - Updated risk assessment and mitigation
  - Updated detailed cost and schedule estimates
  - Updated safety analyses
  - Acceptance criteria
  - Updated verification/validation plan

- CDR Level Exit Criteria
  - Detailed design meets early science requirements with adequate margins at an acceptable level of risk
  - Interface control documents are sufficiently mature to proceed with procurement, fabrication, assembly, integration, and test
  - Adequate technical and programmatic margins exist to complete development within budget, schedule, and risk constraints
  - Risks to mission success are understood and mitigation plans developed
  - Safety and mission assurance has been addressed
  - Gov Mandatory Inspection Points identified

21.3 *Connectors/Cables/Harnesses*

Connectors, cables and harnesses shall be permanently identified. Connectors shall be uniquely identified. Power and signal, separated except where identified and agreed otherwise in PDR or CDR. Cables and harnesses shall include instruction for hot potential testing in the drawing.

Interface design information shall include the wiring, signal description, grounding, labeling ID method, connector type/part number (e.g. manufacturer's spec sheet), locking feature, pin-out, part number, disconnect features (guillotine, lanyard, sequence-ground last pin out, etc.). Information, such as in a note, needs to identify fiber optics and signal protocol as well.

21.4 *Growth*

The product design shall allow for potential or anticipated growth. The card rack for example shall provide extra wired slot(s); power supplies shall be sized to provide reserve current capability for functional growth (defined to be at a minimum, incorporation of all potential optional features with regulation such that all secondary voltages are within operational limits over all normal primary power operating conditions); wire harnesses shall be sized for current carrying capacity; connector plugs shall be populated to ensure EMI integrity, with spare pins for empty connector pins procured for future use; computer memory sufficiently sized to assure no performance degradation; fiber optic and electrical wire/harness runs designed for consideration of distance, connections/junctions and signal losses, etc.

21.5 *Start-Stop, Boot-up*

The Supplier shall identify any sequence specific start-up or shut-down sensitive processes or sequence. The Supplier shall test and measure boot-up time and report to the COTR results and effects of re-booting during normal operations as well as from cold start. The Supplier is responsible for assuring product integrity to assure there is no disruption, interference, stalling, "lock ups" due to internal incompatibilities or specified interfaces (as anticipated between other aircraft assemblies).

21.6 *Warm-up*

In the absence of contract specification otherwise, each product shall be capable of meeting its performance requirements after application of electrical power following thermal stabilization of the product with power off at ambient air temperature as low as -40 degrees C or as high as +71degrees C. The warm-up time for each product to meet its full performance requirements from an initial temperature of -40 degrees C shall be not more than 1 minute and shall provide some obvious indication to the operator and interfaced units to recognize stale data/information.

21.7 *Flight Test Vehicle Power*

In the absence of contract specification otherwise, each product shall operate properly with anticipated (contract specified) power sources except that the product does not have to demonstrate hold-up following power loss. Power interruptions shall not however, cause permanent degradation to the product. In the absence of contract specification, MIL-STD-704E applies.

21.8 *Overload Protection*

In the absence of contract specification otherwise, the power conditioning design of product(s) shall provide a means of protecting: (1) the internal downstream components from over-voltage conditions as may present on the input; (2) the input power cabling from over-current conditions, which may result from product failure; and (3) the internal product components from sustained overload conditions as a result of product internal circuit failure.

21.9 *Momentary Power Interruption*

In the absence of contract specification otherwise, each delivered product shall not incur any damage as a result of a momentary power interruption.

21.10 *Interlock Shutdown – Data*

In the absence of contract specification otherwise, the product, particularly those with internal batteries, shall be designed with hardware interlocks, which inhibit any data transfer to the aircraft subsystem during or after removal of power to the product.

21.11 *Protection – High Voltage*

In the absence of contract specification otherwise, each product with high voltage capable of injuring personnel shall be designed with power interlock shutdown or sufficient shields, covers, etc. to ensure personnel cannot inadvertently be injured during powered condition of the product. For example, opening access doors where a technician might touch high voltage results in killing high voltage power. However, clear plastic shielding may be adequate, as determined in PDR/CDR.

21.12 *Stored Energy Personnel Protection*

Each product capable of storing energy (pressure tanks, electrical capacitors, batteries, etc.) shall designed to minimize/eliminate risk of injury to personnel or damage to surrounding components.

21.13 *ESD Sensitive Components*

The Supplier shall design to protect sensitive components, with particular attention to connectors and ESD, or other product functional features where it is likely that technicians or users might compromise the product in normal installation, operation, or maintenance.

21.14 *Reset Switch*

The Supplier shall provide a permanent mechanical reset switch for accomplishing a "warm re-boot" of microchip embedded product(s). The reset switch shall be accessible to the operator (gloved finger) once installed in the aircraft, but shall be designed to eliminate operator confusion and erroneous activation – as determined by PDR/CDR. (Examples: reset switch protected by flip up cover or installed to preclude inadvertent operator activation, e.g. oriented and located on the side of a cockpit bezel to assure activation is orthogonal to normal switch motions.)

21.15 *Reliability*

In the absence of contract specification otherwise, each product shall achieve a Mean Time Between Failures not less than 5,000 hours operating as defined by MIL-HDBK-781.

21.16 *Calibration and Initial Settings*

The Supplier shall identify to the COTR and perform initial calibrations, settings as necessary for later use.

21.17 *Flammable/Toxic Materials*

The Supplier shall assure that product(s) do not contain carcinogens, flammable or toxic materials, e.g. polyvinyl chloride, mercury, lithium, etc. See **Flight Worthiness** element.

21.18 *Human Factors, Displays*

Displays shall not use blinking characters, environmentally unreadable information, contradicting symbols, or other confusing features. Unless specified otherwise in the contract, all displays shall be sunlight readable from a distance of three (3) feet. The Supplier shall randomly test human

interfaces for multiple/simultaneous button depressions, key bounce, and rapid key inputs (5 times per second minimum).

21.19 *Displays*

In the absence of contract specification otherwise:

Product display screen(s) shall be designed as readable in sunlight and for cockpit displays, backlit for night time operations, dimmable, high contrast and if graphics is required, minimums of: 800 x 600 resolution; color: 256 color minimum.

The display's viewable area shall be defined as a primary viewing cone bounded by no less than 40° degrees from normal to the surface of the display.

The product shall not have any power energy saving feature, which could become a safety-in-flight issue, unless sanctioned otherwise by the COTR in writing or PDR/CDR agreement.

Display Point and Cluster Defects. A failed subpixel shall be defined as any independently addressable element such that light transmission through the pixel cannot be controlled. Total failed subpixels shall not exceed 50 and shall not exceed the requirements of Table 1 below. No failed ON subpixel shall be failed to the text color. In the event that criteria for failed pixel or cluster defect or group of defects defined herein allows more or worse defects than is used by the manufacturer of the display part, the lesser defects criteria shall prevail.

A failed ON subpixel continuously or sporadically allows the transmission of light. A failed ON subpixel provides 20% or more greater luminance than it should when commanded to the off-pixel (0 grayshade) state. A failed OFF subpixel continuously or sporadically does not allow the transmission of light. A failed OFF subpixel provides less than 20% of maximum luminance when commanded to gray shade 63. Any adjacent failed subpixels are clusters. A cluster includes 2 or more adjacent subpixels. Total cluster defects shall not exceed the requirements of Table 2.

Table 1. Display Point Defect Requirements.

	Failed On Subpixels	Failed Off Subpixels
Max. No. of Allowed Defects	10	20

No cluster shall include both failed On and failed OFF subpixels. There shall be no failed clusters of 4 or more subpixels. No cluster shall include more than one failed green subpixel. No cluster shall be within 2 inches of any other cluster.

Table 2. Display Cluster Defect Requirements

Cluster Size (subpixels)	Max. Failed ON	Max. Failed OFF
2	8	12
3	0	1

Display Blemishes. All defects on the display, except subpixel defects, if visible (per conditions described below) shall be limited as specified in Table 3. In the event that criteria for blemishes herein allows more or worse blemishes than is used by the manufacturer of the display, the lesser criteria (better display) shall prevail.

Table 3. Display Non-Uniformity Blemish Requirements

Blemish Size*	Max Qty. Allowed	Remarks
>0.50 mm	0	
0.15 mm - 0.50 mm	10	Min. separation 12.5 mm
<0.15 mm	No limit	Concentrations resulting in a smudgy appearance are not allowed.

* Blemish size is determined by approximation of: (Length + Width) / 2.

Display Visual Criteria. Except as allowed for point defects, cluster defects and blemishes, there shall be no defects (including scratches, line outs, row outs, bubbles, rub lines, polarizer stretch, etc.) visible to the naked eye as viewed within the primary viewing cone in the conditions of:

1. 10,000 fc diffuse and 2,000 fL specular ambient lighting (product in day mode set to maximum luminance), or;
2. Dark ambient conditions (product in night mode, set to comfortable viewing luminance within 0.05 to 0.5 fL white).

21.20 *Switches and Controls*

In the absence of contract specification otherwise, the product's switches/controls shall comply with the following:

Rotary potentiometers and switches shall not have dead spots. Momentary switches shall provide tactile feel similar to a standard computer keyboard.

A. Switch types and user (programmable) definable controls shall be clearly identified to the COTR during PDR/CDR and drawing/specification. The design shall take into account use and environmental considerations to determine switch types and features (rotary, pushbutton, commentary, latching, rocker vs. toggle, lock, etc.).

B. There shall be no switch bounce.

C. Controls shall be clearly labeled with sufficient contrast to be readable under all conditions. Location and sufficiency will be discussed/established during PDR/CDR, but ultimately determined acceptable or not once all testing by Supplier and Project is completed.

D. MIL-STD-1472 requirements for bare hand, flight glove and cold weather gloves shall apply to all cockpit controls. White markings shall be IAW FED-STD-595 white, No. 37875. Switches for cockpit use shall be located in such a fashion as to be operational by a gloved finger.

E. Barriers shall separate all pushbuttons in cockpit controls. Button separation shall provide a minimum 0.5 inch by 0.5 inch area within the separation barriers for each button. Button caps shall be minimally 0.375" square.

F. Each switch and control shall transmit change state information to the products' exterior interface within 33 ms.

G. The issue and potential hazards of stuck switch/control impact to aircraft shall be addressed at PDR and CDR.

22.0 Flight Test Data Instrumentation

Research data for the experiment can be separate from, or integral to, the aircraft. A good Data Analysis Plan can be extremely helpful when identifying instrumentation needs/requirements.

Date required must be identified and coordinated with the NASA/DFRC Instrumentation Engineer as part of a instrumentation parameter list document. Proposed items to be tracked within the instrumentation parameter list document for all measurements shall be as follows:

- Parameter ID (per proposed naming convention)
- Parameter Mnemonic (7 characters, if desired by working groups)
- Parameter Description
- PCM Sample Rate (SPS)
- Word Size (# bits)
- EU Range Required (Min & Max)
- Engineering Units
- Criticality (MC, FS, R, ... other?)
- Accuracy (% FS)
- Measurement resolution (EU/data count)
- Filter information (type and cutoff freq.)
- Electrical interface drawing number
- Sensor installation drawing number (if applicable)
- Location coordinates
- Data Type (offset binary (OB), 2's compliment (TC))
- Sensor Manufacturer (Mfr)
- Point of contact (working group or individual) (POC)
- Measurement justification
- Additional relevant remarks

Sensor selection must support at least one specific requirement and must be identified and location narrowed by the time of the CDR. Design detail leading up to and following PDR must be sufficient to make selection and purchase immediately following the CDR possible.

The Project Instrumentation Engineer will establish preferred format. A sample Instrumentation Parameter List is provided in Appendix B.

COTR designated representative (typically Instrumentation Engineer) shall witness installation and calibration of each sensor when it is installed and especially wherever it cannot be inspected after assembly.

Data parameters necessary for flight to proceed must be identified as "Go/No-Go". Those necessary for Mission Success must also be identified to ensure that if one is nonfunctioning on day of flight the control room staff can determine to proceed less those flight test points where the parameter is needed.

23.0 In-Process and Final Audits

The Supplier shall support and coordinate in-process and final audits of products. These audits shall coincide with critical points in assembly, inspection, measurement and test, such as when critical components are buried from view during assembly process into a consuming assembly.

The audit shall consist of inspection and as necessary measurement and test against design documentation with focus on interface characteristics to higher level consuming assemblies, including the Aircraft itself. These audits often identify "show stoppers" which when corrected benefit the Supplier and Project. Verification by the COTR or NASA Quality Assurance shall not be used by the Supplier as evidence of effective control of quality by the Supplier and shall not absolve the Supplier of the responsibility to provide acceptable product(s) or services, nor shall it preclude rejection by the Project.

The Supplier's and NASA's quality system evaluation may be conducted as a single audit or as a combination of discrete audits that collectively cover all required quality system elements. Quality system audits shall be performed and documented following written audit attributes, such as provided in AS9101, Quality System Assessment and DCP-S-006, Quality Assurance Audits.

The COTR or NASA Quality Assurance's representative(s) shall be afforded the right to verify at the Supplier's premises and the affiliated organization(s) premises that product(s), processes, and services conform to requirements.

At least thirty (30) business days before starting the operation, the Supplier shall propose ideal in-process audit points with dates to the COTR where there will be minimal or no impact to any of the Supplier operations. The Supplier shall provide Advance Notice (Element 34.1) to the COTR prior to starting each Formal Audit event to coordinate COTR representation/participation. The COTR will assure competent internal personnel (normally the Quality Assurance, Systems, and/or Chief Engineer) support the in-process audit as necessary. The Project reserves the right to audit at any time.. Tear down audit is highly unusual and unlikely and requires coordination with the COTR before commencing. Timely in-process audits normally ensure tear down of any product of its subassemblies for audit purposes is not required. Defects shall be sufficient cause to tear down and audit products as determined by the COTR at no cost to the government.

The COTR and DFRC Quality Assurance Office (Code SQ), reserve the right to audit, measure, witness test etc. as may be required to assure compliance to requirements at subcontract levels to reduce costs and eliminate delays which could result in the delivery of suspect or defective product otherwise. The government's primary objective is to assure compliant product(s) are delivered on time. This does not remove or modify any Supplier obligation. Where identified as a mandatory inspection or formal test and Supplier proceeds at risk without COTR representation to participate in or witness the event, that event shall be repeated at no additional cost to the government upon request of the COTR.

The Supplier shall provide access, parts, facilities and hard copy of all necessary drawings, documentation and records as determined by the COTR's on-site representative to expedite the process. These copies shall be used for measurements and can be expected to be marked up and form part of the historical record of the audit.

The COTR will initiate an Audit Report, at least some of which ideally will be completed at the Supplier's facilities. The Supplier shall close all action items identified as the Supplier's responsibility and provide evidence of closure to the COTR prior to start of test and delivery of product to NASA.

23.1 *Audit Process*

The Supplier shall provide audit representative(s) with legible copies of drawings, specification, material test and/or certification sheets, deviations/waivers, nonconformances, use-as-is and all other requested documentation related to the product(s) being audited.

The documentation shall be compared to release status as predicted by the Design Agent's configuration system. The Audit Team will retain documentation examined in the audit as evidence of the audit.

Suppliers may participate in NASA Quality audits only to the extent required as determined by the Project's audit team. The Supplier shall immediately work/close action items resulting from the audit.

The audit team lead shall provide an audit report to the Project Control Board when complete. Where prudent or possible, in the determination of the Audit Team Lead, a copy will be provided to the Supplier and the Design Agent.

Functional Baseline Audit. To support establishing a Functional Baseline, NASA Software Quality Assurance will audit software products and processes in accordance with the Project's Software Assurance Plan. This audit may draw upon NASA Project expertise, but is independent of the Project. In addition, the Project Software Manager will also audit software products and processes typically against the Supplier's Software Development Plan and internal processes).

Quality Data Analysis. The Supplier shall support the Quality Data Analysis performed by NASA Quality Assurance. Quality data consists of records supporting verification (requirements matrix), validation, audits (Audit Reports), inspections, test procedures, test data, test results, problems (Discrepancy Reports), material review dispositions, repair/rework activities, log books, calibration records, GIDEP reports, and configuration records.

Quality data shall be reviewed to identify problem areas, common deficiency causes, quality trends, defect anomalies, and process variations. The NASA Quality Assurance representative will evaluate data at periodic intervals for the purpose of:

A. Adjusting the frequency of Quality Assurance oversight actions, including allocation of NASA's Quality Assurance personnel resources.

B. Providing supporting rationale for acceptance/rejection of the Project's and Supplier's quality system and/or written procedures.

C. Initiating corrective actions based on identification of systemic problems and trends.

D. Sharing analysis with Project and DFRC management to identify quality trends and areas of weakness.

Project In-Process Audit Report. The Supplier and COTR representative(s) will coordinate an in-process audit or audits to expedite confirmation of physical attributes prior to final formal test prior to delivery. The audit shall consist of measuring hardware to drawings, reviewing materials reports (if any), inspection records, comparing to configuration control documentation (e.g. deviations/waivers, use-as-is dispositions, change documentation, history) and manufacturing/fabrication and subcontractor documents as appropriate. Ordinarily, the Project shall be concerned with simply the interface to next using assembly, particularly with regard to the Aircraft configuration level and compliance to associated drawing package for those areas. However, experience has demonstrated that the earliest possible/practical opportunity to perform a wider audit usually benefits both Supplier and Project. The COTR and NASA Quality Assurance shall determine scope, but typically audit will remain concerned with next using assembly and flight vehicle level.

23.2 *Pyrotechnics*

Pyrotechnics will be received, handled, stored and tested in accordance with DFRC Quality Attachment Q17and follow requirements of AFM 91-201 and NASA Standard NSS-1740.12.

23.3 *Tamper Indicators*

In light of the potential property damage, liability, injury or death to the public resulting from compromised pyrotechnics (such as FTS), it is in the interest of both the government and Supplier to provide visual tamper indication for pyrotechnic items. Suppliers assembling and/or installing pyrotechnics must inform NASA Quality Assurance sufficiently ahead of the operation to assure access and if appropriate close-out photos.

NASA Quality Assurance reserves the right to apply tamper indicators for other items as well, e.g. Qualification units during test, sealed deliverables, etc.

NASA/DFRC Quality Assurance or FTS Lead Engineers (within this element called "NASA representative") will apply tamper indicators such as "green stripe" or a Quality "seal" as determined appropriate by the NASA representative (e.g. enclosure covers, connectors to FTS Receivers, FTS Relays, Safe & Arm Relays, initiators, etc.) Typical planned green stripe material: F925SKYDROL, as primary tamper indicator with Quality seal NASA/DFRC P/N 20195T3 as secondary tamper indicator. In no case shall paper or electrically conductive seals be used. See figures for examples. Unless authorized by the COTR, only NASA's representative shall break, replace, or apply any tamper indicator. These tamper indicators do not typically require Supplier documentation.

Color green is reserved to NASA Quality Assurance representative.

The indicators shall not be violated without NASA representative witness present. The Supplier shall immediately notify the COTR in the event of accidental or intentional break or degradation of any tamper indicator.

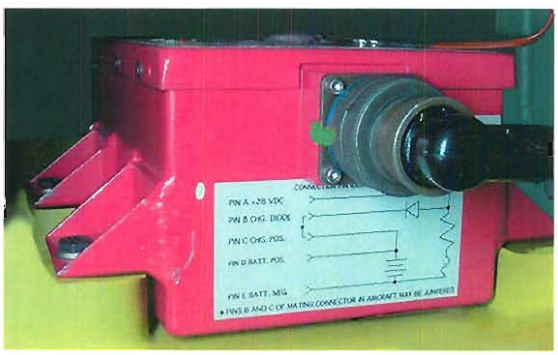

Figure 1. Tamper Indicator (connector) - Green Stripe

Figure 2. Tamper Indicator – "Egg Shell/Onion Skin" Quality Seal

See **In-process Audit** element.

The Supplier shall assure the NASA representative is present for critical FTS operations. At that time, or when judged appropriate by the NASA representative in conjunction with the Supplier tamper indicators shall be applied. If mutually agreed between the Supplier and NASA representative, a designated competent Supplier person may install tamper indicators, but informed consent of NASA representative is required in each case.

Close out photos shall be taken of the installed tamper indicators, as well as of modifications, repair, and use-as-is areas of the aircraft and flight worthy items before they are closed off or become inaccessible. Either the NASA representative or Supplier may take the photos, which will subsequently be made available to the Supplier for screening out potential security or proprietary information, typically consisting only of identifying which photo shall be marked proprietary in accordance with **Marking** element. Where the Supplier does not allow the government to photograph, the Supplier shall photograph each tamper indicator with the NASA representative present and provide electronic (JPG format) file and hard copy to the COTR at no additional cost. FTS close out photos must be filed with the NASA/DFRC FTS Lead Engineer.

23.4 *Stamp Control, Warranty, and Procedures*

The Supplier shall establish and maintain documented stamp control policy, warranty, and procedures in a Supplier Quality Management document applicable to the Project work. Initials shall be warranted exactly the same as a stamp. The stamp warranty program shall state that utilization of a stamp (initials or signature, as applicable for individual attestation of documents) shall be a professional, individual warranty (guarantee) that the operator / inspector personally saw, witnessed or performed the work (task) literally as specified in the document being initialed or stamped. Stamps will be traceable to individuals responsible for their use, and records shall be maintained to identify individuals assigned specific stamps. Stamps issued to personnel being transferred or terminated shall be returned and not be reissued for a period of at least six months. Worn or damaged stamps shall be destroyed at the time replacements are issued.

If/when a stamp, initials, or signature is applied, the person who signed or stamped originally shall be informed and provided the opportunity to re-accept or reject any subsequent change/redline.

23.5 *NASA/DFRC Approved Sources*

When clearly applied in the contract, NASA DFRC QA reserves the right to verify Supplier and subcontractors quality management system with an appropriate audit.

24.0 Marking

Marking shall be permanent and of contrasting color or embossing or type sufficient to assure easy identification and shall be compliant with FARs.

The Supplier shall identify, label, proprietary, sensitive or classified information/product(s) as provided by law and the Purchase Order/ Contract.

Design documentation funded in whole or in part by government shall be permanently marked with the contract number.

Configuration / Environmental Marking. Each product shall be marked sufficiently to identify proper configuration. Small items or software loads may be identified in associated paperwork, container, bag or tag, which shall be packaged with, attach to the delivered product.

Proprietary Marking. The COTR and Supplier shall agree in writing to proprietary claims before marking any item as proprietary. See Proprietary/Sensitive/Classified Information/Products. Proprietary deliverables shall be marked in accordance with the Data Rights clause in the contract.

The Supplier shall clearly mark documents and slides/briefings containing proprietary information on the cover sheet/slide and appropriately mark only those sheets/slides within that contain proprietary information. The Supplier shall similarly mark sensitive and classified material (except as may be defined otherwise by law or contract). Universally marking items proprietary or sensitive is unacceptable.

Unless provided otherwise in the contract, distribution will be determined by the COTR.

ESD Marking. Where electrostatic discharge may damage the product, the Supplier shall ensure adequate marking to warn handlers, installers and technicians of the potential hazard using conventional symbols or language, e.g. "Warning – ESD Sensitive." This includes exterior package notifications to assure no one opens and inadvertently degrades or destroys product contents within.

NOT FOR FLIGHT Marking. For those products (e.g. software, power supplies, prototype items, etc.), which cannot comply with requirements, the COTR shall be informed and consulted. Where the COTR concurs in writing, the product(s) shall be permanently marked on or near identification label with "NOT FOR FLIGHT". Where this is not possible, the product (e.g. circuit card assembly) shall be marked with a blue stripe diagonally applied over the product.

RD/W Marking. Products where a permanent (normally hardware) Request for Deviation/ Waiver applies shall be permanently labeled with "RDW" and where possible, the applicable reference number, allowing rapid reference to Configuration Management records.

Hazardous Materials/Special Handling. The Supplier shall provide sufficient markings to assure that a reasonable person can read English, understand, and take whatever precautions are appropriate to protect people and the product itself.

25.0 Non-conforming Materials, Deficiencies/Corrective Action

Under no circumstances will nonconforming material be delivered to the government without prior written informed consent of the COTR and DFRC Quality Assurance – even in the event that the government has directed a specific resource, vendor, subcontractor, etc. The Supplier shall immediately identify, analyze, and apply effective corrective action(s) to rectify any discovered problems affecting or within deliverable products.

Product that does not conform to drawing and/or specification requirements shall be identified and controlled to prevent its unintended use or delivery.

A. Nonconforming item(s) shall have tag attached describing problem.

B. Tag identification (number) shall be referenced in documentation where the defect was discovered.

C. Tag shall stay affixed to the item until engineering disposition is completely complied with.

D. Nonconforming item, if not installed, shall be segregated from conforming items to prevent co-mingling.

E. Corrective action requests shall accompany non-conforming product. Investigation shall identify root cause, corrective action taken, replacement, repair, or authorized disposition of non-conformance, and implementation of preventive measures to eliminate the cause, and validation that implemented preventive measures have effectively eliminated recurrence.

Any product or component dropped or potentially contaminated or damaged otherwise (e.g. electrostatic discharge, dust, moisture, scratched circuit, etc.) while in the custody of the Supplier shall be inspected, reworked as required, and if a functional part, re-tested by the Supplier. The Supplier shall provide the COTR with details of the event as well.

In those instances where rework or repair or substitution has resulted in re-test or degradation of final product, the Supplier shall also provide corrected problem report (CPR). The CPR shall be in Supplier format and provide: date of discovery; scope, part number or series or serial number; description of discrepancy; corrective action(s) taken; customer contacts informed of the discrepancy. Example "*CCA 3648776-001, S/N 001 failed test 1 Dec 05. Other CCAs are not affected. The 28 volt Mini-power supply P/N 1234 was replaced with 0.2 oz heavier substitute P/N 432 and re-tested to entire procedure XYZ-001-Rev C, by Dave Smith, 12 Dec 05, passed all tests, RDW -001 exempts increased weight and part substitution. Customer DFRC rep J.Brown informed and NASA/DFRC concurred with shipment as-is via email 13 Dec 05. NASA DFRC to perform environmental tests to demonstrate usability before formal acceptance.*"

In the event that the Project directed or authorized integration of a nonconformance, the Supplier must include reproducible copy of the document of direction or authorization (e.g. RDW, letter of direction, CPR, etc.) with the delivered product.

Without mutual disposition to proceed, the Supplier proceeds solely at the Supplier's risk.

25.1 *Unexplained Anomaly (Cannot Duplicate)*

If troubleshooting cannot duplicate nonconformance, and the decision is to accept the condition, the Design Agent shall provide documented rational/conclusion why the anomaly should be accepted. The NASA Operations Engineer must sign for concurrence and this paperwork must accompany the delivered product.

25.2 *Repair/Rework*

See **Definitions**.

The Supplier may rework product without government involvement.

The Supplier shall not repair without written, informed COTR consent. Supplier information to the COTR must include description of discrepancy, photos if any, test/measurement data, proposed repair process and rational why the discrepancy should be accepted with responsible design engineer concurrence. Where the COTR authorized repair of returned product or where a Material Review Board is not authorized by the CO, the Supplier shall transfer discrepancy and description of repair action(s) to a Project DR form. (See Definitions).

Removed/Replacement Parts. In the event Government product is returned for repair/rework, the replacement items shall be (1) functionally and physically identical/interchangeable and; (2) replacement parts are new, or refurbished acceptably to DFRC Quality Assurance.

Parts Control Tag(s) associated by NASA to each returned product shall be shipped back with the returned product.

Substitute Parts. See **Configuration Control**. The Supplier shall ensure that any substitute and replacement parts and/or assemblies are identical in reliability, form and function, and do not adversely affect software developed by Project or Supplier for any consuming product(s). Otherwise, each non-warranted repair shall be separately negotiated on a case-by-case basis.

Use-As-Is Disposition. The Supplier remains solely responsible to assure products conform to requirements/specification(s). Use-as-is disposition is reserved exclusively to the Project.

Decisions to dispose of assets with potential adverse affect upon cost or schedule to the Project reside solely with the Project itself. The Supplier shall involve the COTR in decisions such as "use-as-is" or where discrepant material could potentially end up within deliverable products or used in contracted services. In either case, the COTR reserve the right to veto and reverse the decision to "use-as-is". The NASA/DFRC Operations Engineer signature, as a minimum, is required to approve the "use as is" disposition.

Supplier MRB. Authorization for Contractor or Subcontractor MRB shall be exclusively through the NASA Contracting Officer in writing and may be terminated at will by the Contracting Officer. At minimum, the MRB shall consist of Design Engineer, Quality Assurance, NASA Ops Engineer and NASA Quality Assurance. If Supplier MRB is not authorized, any "use-as-is" or other MRB actions/dispositions shall be processed through the COTR.

26.0 Simulation

The Supplier shall include verification and validation records with delivered simulators and simulation.

Where contracted for aircraft software simulation, the Supplier shall provide simulation models of the real item's characteristics (e.g. power consumption, thrust, gimbled nozzles rates, ranges, etc.), control laws, algorithms, test cases, aerodynamic model, guidance, navigation, sensor feedbacks and locations, and mass properties. The Supplier shall provide source code and documentation for the above models as well as orientation reference frames and everything necessary to prepare a simulation of the entire flight profile, including trajectory analysis and if there is an FTS, with FTS fired and not fired. The Supplier shall provide updates as they occur. The Supplier shall provide the Project with technical support and check cases to verify the NASA simulation. Initial submission will contain Modeling & Simulation Support Plan, an initial system architecture model, and discrete-event simulations. The deliveries will start at PDR and continue thereafter.

Any flight support software used for validation shall meet classifications standards specified by the COTR (Project Software Manager). Ordinarily, simulation used for verification/validation purposes must be of the same classification of the unit under test, which is or will be verified/validated.

27.0 Packaging

Packaging shall comply with Contract, Section D.

The Supplier is encouraged to propose re-useable containers, if appropriate/cost effective and mutually beneficial to the government and Supplier. Static generating dunnage shall not be used for ESD sensitive devices, which shall be packaged in ESD protective bags or containers.

28.0 Principal Contacts

The COTR shall identify principal contact information on an as needed basis.

29.0 Safety / Hazards

The Supplier shall immediately, upon discovery, identify in writing to the COTR any hardware or software safety, required training, or hazardous issues or materials related to deliverable product(s).

30.0 Personnel Protection Equipment (PPE)

The Supplier shall provide effective Personnel Protection Equipment (PPE) and shall ensure its proper use by Supplier personnel. This includes eye, ear, hand, and foot protection in accordance with NASA obligations when at NASA facilities or aircraft.

The Supplier shall consult the COTR (or for aircraft access, the Lead Operations Engineer) before travel to NASA to ensure PPE is brought with the Supplier personnel and worn appropriately. It is not unusual for NASA to provide simple generic ear and eye protection, but NASA does not provide special fit or personal items (e.g. Safety shoes, hearing impaired equipment, prescription safety glasses, etc.).

At all times on aircraft, footwear shall be closed toe. In areas where hazardous liquids or fuels are handled/processed, canvas or cloth sneakers and porous shoes with breather holes are prohibited.

Additional foot protection (e.g. Safety steel toe) may be required for personnel that are exposed to potential foot injury hazards, such as the lifting of heavy objects (e.g. Installation of avionics boxes, test equipment, large batteries, etc.). If in doubt while on site, consult QA or operations engineering. If certain PPE is written into a hazard analysis or procedure that is being accomplished (such as the requirement for safety shoes during the critical lift) then it will be enforced as well.

31.0 Software

Software Quality Assurance shall comply with the Project Software Quality Assurance Plan (SQAP).

Software development shall comply with the Project Software Development Plan (SDP).

Purchased Software/Firmware – Any flight software that is procured must comply with the SDP. Contact the COTR (who will coordinate with the Project Software Manager) prior to purchase. Unless specified by contract otherwise, purchased software, which forms a part of each deliverable product, or is required to program each product (e.g. Operating System, Diagnostics, Compilers, Assemblers, etc.), shall be identified to the COTR in the shipping document or in separate list prior to delivery. Delivered product shall include original disk(s), operating manual(s), warranties, product keys and/or passwords provided by the OEM for the device or software.

License. The Supplier shall provide the COTR with all software and related license(s) upon delivery of each deliverable product. The Supplier shall issue a permanent, license to the COTR for software developed using government funding allowing unlimited use, modification, and dissemination unless directed otherwise in the contract.

Developed Software. A loop-back diagnostic shall be provided for driver and receiver operation, IRQ selection and address verification.

32.0 Spares

The Supplier shall ensure that any and all spares are fully interchangeable in form, fit, performance, weight, and flight worthiness, and other characteristics/performance. Any variance must be identified to the COTR and the COTR must agree to accept each spare product and/or service with variance prior to delivery. All other requirements of this SSOR applicable to the parts being replaced are applicable to the spare(s).

33.0 Structures /Loads

The COTR will be provide specific Structures / Loads requirements through other documents.

34.0 Test and Acceptance

NASA shall accept no product(s) until and unless each product delivered has passed all formal tests and complies with all design documentation and Project requirements. The Supplier shall submit a V&V plan illustrating the process to be used by the Supplier to demonstrate that each of the contract technical requirements are met and documented. If the COTR and/or Quality Assurance representative elects to witness test, the test shall not proceed until their representative or delegate is present or allows the test to begin / continue.

The Supplier shall perform a comprehensive test, inspection, and audit of each product to drawings, design and requirement documentation to verify requirements have been complied with to the mutual satisfaction of both COTR and Supplier prior to delivery to NASA/DFRC.

Clear, readable, reproducible quality test data sheets that identify who participated, product description (title, part number, serial/sequence number, etc.), date of test, list of all closed anomalies, test procedure redlines, and final test conclusions shall be provided with each product delivered. Separate test report may be used rather than test data sheets, but must provide same information identified above. The COTR and/or Quality Assurance's representative present for the event shall be entitled to hard copy upon request, ideally automatically given at close of each day's test operations.

First product's formal test(s) shall be comprehensive. With informed, written consent of the Project's CCB, subsequent units may be allowed to test using a less rigorous or simplified "acceptance" test. See **First Article**.

In-Process Audit Prerequisite. The Supplier shall assure that all In-process Audit action items associated with the product are closed to the mutual satisfaction of COTR and Supplier before delivery. The Supplier shall provide evidence to the COTR prior to start of test and delivery of product. See **In-process Audits** element.

34.1 *Advance Notice*

The Supplier shall notify the COTR and NASA Quality Assurance, normally at least ten (10) working days in advance of test or final inspection, allowing NASA Quality Assurance and the COTR's representative(s) to exercise the option to witness and/or monitor the product tests and final inspection. Ideally there will be test readiness steps leading the test procedure, but if not, the Supplier shall ensure before start of test that the product is ready for formal test(s). See Test Readiness below. Upon request, the Supplier shall provide evidence to the COTR that the product and staff are ready for test.

34.2 *Test Readiness Review (TRR)*

The Supplier shall submit for approval, and conduct a TRR for each formal inspection, test, and in the case of large complex items, mating, integration, or moving operation. The TRR shall review all associated documentation to ensure the operation is ready to proceed. The TRR obligations may be either integrated as part of the related test procedure (preferred) or separate document.

The following items should be considered and supporting records made available for review as part of the TRR:

- Receiving inspection records
- Evidence that all operations are complete (e.g. assembly, inspections, tests, etc.)
- Product is clean and free of debris
- All related discrepancies are closed with meaningful corrective actions
- Aircraft workbook/NALCOMIS (if aircraft is involved)
- Configuration list for the item(s) involved has been verified (PCA/FCA)
- Test integrity
- Discrepancies/inspection findings completed/closed
- Procedures completed
- Assembly/inspection/test operations are complete
- Markings are proper, accurate and legible
- Test equipment is calibrated
- Properly trained competent test staff is ready
- COTR and/or NASA Quality Assurance representative(s) are ready/available for duration
- Photos taken (mandatory for Qualification test or Flight Termination System items)
- Qual unit marking acceptable (default: blue stripe from corner diagonally opposite corner)
- PCA/FCA complete

34.3 *Formal Test*

See **Formal Test** definition.

Formal tests shall be planned, controlled, reviewed, and documented by the Supplier to ensure and prove the following:

- Test plans or specifications identify the product being tested and the resources being used, define test objectives and conditions, parameters to be recorded, and relevant acceptance criteria,
- Test procedures describe the method of operation, the performance of the test, and the recording of the results
- The correct configuration standard of the product is submitted for the test,
- The requirements of the test plan and the test procedures are observed,

- The acceptance criteria are met.

Each formal test shall be conducted using a COTR approved test procedure with accept/reject criteria. Test results shall be recorded on test documentation at applicable step/sequence. The Test Conductor shall record anomalies on a Discrepancy Report with sufficient analysis performed to determine if the unit under test has passed or failed the suspect criteria. Test results must be auditable, i.e. legible, repeatable and complete.

Functional items shall be tested to pass/fail criteria, which is auditable, uniform, repeatable and traceable to design requirements.

The COTR and/or NASA Quality Assurance representatives plan to witness all formal tests.

The COTR and NASA Quality Assurance representatives shall be informed of any departures from test procedures, including sequence unless the test procedure itself allows execution of sub-tests out of sequence.

During test, test data, records, redlines, etc. associated with the test will be retained by the NASA Quality Assurance representative.

When a problem is identified, a Discrepancy Report shall be issued, Any discrepancies shall be identified, tracked and corrected.

The Responsible Engineer (design, ops, systems, etc.) assigned to respond to the Discrepancy Report shall assure effective corrective action(s) promptly resolve the problem at root cause.

34.4 *Informal Test*

Informal tests, such as engineering evaluations, are not ordinarily related to formal test activities. The COTR is not obliged to witness informal tests, except where those tests directly support formal test. For example, if an anomaly is observed during formal test, the Supplier must invite the COTR and/or NASA Quality Assurance representative to witness informal test(s) that demonstrate the anomaly is irrelevant. (Repeating and passing formal test steps proves compliance otherwise.)

34.5 *Final Acceptance.*

The Contractor/Supplier shall perform a comprehensive test, inspection, and audit of each product to drawings, design and requirement documentation satisfactory to both Project and Contractor/Supplier prior to delivery to NASA.

Final acceptance consists of compliance to contract requirements, formal tests, inspections and mandatory inspections identified by the COTR and/or NASA Quality Assurance representatives.

Note that in some cases final acceptance is not complete until formal test(s) are completed at NASA/DFRC (e.g. environmental tests, materials test, etc.)

The COTR and NASA Quality Assurance shall accept no product(s) until and unless each product delivered: has passed all tests; complies with all requirements; all failures are closed; and all anomalies rectified/closed. Unless the contract directed otherwise, final acceptance shall be at NASA/DFRC and is reserved to the COTR and NASA Quality Assurance following receipt at NASA/DFRC as indicated by signing the Audit Report after all open items on the report are closed to the mutual satisfaction of COTR and Supplier. Delivery before closure of the Audit Report is at the Supplier's risk. Acceptance of each and all units subsequent to first unit delivered is contingent upon full acceptance of the first unit and passing all environmental tests.

Project Quality Assurance reserves the right to witness or monitor tests, and may elect to not participate in some activities, even delegating some tasks to Contractor/Supplier or other competent agents. However, in such cases the Contractor/Supplier shall not proceed (except at Contractor/Supplier's risk) with planned activity without written authorization from the Project Quality Assurance. Email, fax and letter are acceptable "written" formats.

Upon determination of the COTR, the Supplier or COTR's representative shall perform tear down audit or re-test. This is likely if the Supplier fails to notify in time to perform in-process audit; or to conduct/witness critical/mandatory inspection(s); or witness critical tests closeouts of critical features; or if suspect defective materials or processes were suspected of being used.

COTR and NASA Quality Assurance representatives shall be provided with timely access to product conformity records at supplier's facility. Conformity records shall be retained for a minimum period not less than specified by contract. The Supplier shall notify the CO prior to destruction of records. Records shall show conformity to all requirements specified in engineering drawings and associated specifications. Conformity records shall include, but are not limited to:

- Inspection and test reports for materials, parts, assemblies, etc.
- Travelers, work orders, etc. showing as-delivered configuration – including incorporated serial or lot numbers, applied torques, completed packaging and packing, etc.
- Certification reports and certificates of conformance for processing and non-destructive examination – such as welding, heat treatment, clean room and ESD protected environments, radiography, dye penetrant, etc.

  Certificates of Conformance shall include such key information as:

  - Identification of the delivered drawing/part numbers.
  - Identification of the delivered lot and/or serial numbers.
  - Reference to the contract, purchase order or other requirements being certified.
  - Reference to specific relevant inspection/test records.
  - Name, title, signature and date of the certifying authority."

The COTR and NASA Quality Assurance representatives reserve the right to audit Supplier product records, processes, and witness final inspection of each item before acceptance at Supplier's facilities. See **Flight Worthiness**. This does not remove or modify any supplier obligation(s). The Supplier shall not deliver defective product to the government.

Test data shall not be proprietary information unless agreed otherwise in writing between the COTR and Supplier.

35.0 First Article Inspection (FAI) and First Article Test (FAT)

The Supplier shall perform a First Article Inspection and (where functional attributes exist) comprehensive First Article Test on each delivered hardware and software product offered for final acceptance.

The First Article Test is a Formal Test requiring COTR and NASA Quality Assurance notification and participation.

For each first article, the Supplier shall perform a comprehensive inspection, an audit to drawings, design and requirement documentation satisfactory to the COTR and Supplier prior to delivery.

The First Article Audit is an **In-Process** and **Final Audit** requiring COTR and NASA Quality Assurance notification and participation.

The First Article Audit is also in part a Project Quality Audit, in fact both a functional configuration audit and physical configuration audit to verify that methods/processes used have produced an acceptable item as specified by engineering drawings, planning, purchase order, engineering specifications, and/or other applicable design documents. Therefore, the NASA Quality Assurance representative will monitor/witness tests, and audit test results as determined by NASA Quality Assurance.

36.0 Recycled/Used Product

Unless specified otherwise in writing from the CO, under no condition, shall the Supplier provide the government with new product that contains used or recycled components, assemblies, batteries, etc. without the COTR's informed consent.

37.0 Operation Preconditioning (Burn-in Test)

The Supplier shall perform a burn-in of functional products at least 100 hours of power on, failure free time, if normal testing has not already yielded this result. This includes products returned to the Supplier for repair.

38.0 Tolerance

With the exception of digital, binary test responses, if not specified in drawing or specification, tolerance shall be in accordance with ASME Y14.5M.

39.0 Workmanship Standard(s)

Unless the Supplier's workmanship standards have been accepted by DFRC Quality Assurance in writing, NASA standards shall be applicable. The Supplier shall assure that Commercial Off the Shelf products are compliant to requirements of this SSOR.

Workmanship criteria for items designed by the contractor shall be in accordance with the contractor's Project Quality Assurance approved Workmanship criteria or to design criteria if called out otherwise in the previously existing applicable design documentation acceptable to the government. Unless required for safety or performance, existing design need not be redesigned for later workmanship requirements that may have evolved since original assembly and test of the existing design.

40.0 Warranty

Unless modified by contract otherwise, the Supplier shall warranty both parts and labor for one (1) year beginning with the date of delivery to the government. Rework/repair shall not take more than 30 days after receipt at the Supplier's facility, unless agreed otherwise in each situation between COTR and Supplier.

The Supplier shall forward to the COTR any OEM recall notices or upgrade offers at no additional cost to the government for a period of one (1) year from the date of acceptance by the government for each delivered product excluding damage caused by the government under abnormal use or handling of the product. The Supplier shall identify in writing any potential risk, cost reductions or schedule improvement possibilities for this or follow-on procurements to the CO. In this regard, the CO is open to, and even encourages, use of new technology, products or suggestions to

improve meeting requirements. However, Safety of Flight and Project objectives cannot be jeopardized nor further complicated by proposed improvements, therefore the Project reserves the right to deny or accept any modifications to, or variations from, accepted configuration.

41.0 Shipping Instructions

The Supplier shall not ship short or partial shipments, unless sanctioned by the CO. The Supplier shall expeditiously ship or deliver the product(s), ensuring undamaged receipt at the contract directed destination.

The Supplier shall email the COTR and if known, the chief engineer with the information of what has just been shipped, number of packages, the predicted date of arrival, and shipping agency/name with tracking number(s).

41.1 *Hardware/Software Products Destination.*

Each and all deliveries of hardware and software items shall be made to the address directed by the contract or CO. If not specified in the contract, the recommended format of the shipping container label is:

Attn: <Chief Engineer's name>
SOFIA Airborne Platform Project
NASA Dryden Flight Research Center
Bldg 4840D
Edwards AFB, CA 93524

Note that if deliverables include hazardous materials or explosives, the Supplier shall make arrangements with the CO prior to shipment to assure delivery and clearance with receiving organization(s) prior to shipment..

41.2 *Other Products Destination.*

Paperwork, invoices/billing and contract item deliveries shall be made to the address as directed by the contract or CO. Recommended format of the shipping container label:

Attn: <COTR's name>
SOFIA Airborne Platform Project
NASA Dryden Flight Research Center
Bldg 4800, M/S D2332
Edwards AFB, CA 93524

42.0 Incident/Accident Investigation Support

If a mishap occurs, the Supplier shall assist the NASA Investigating Authority to process DCP-S-001 mishap response requirements including providing the initial information to populate the immediate mishap notification in the online NASA Immediate Response Information System (IRIS). In the event that an incident or accident happens, the Supplier shall, upon request by the CO, provide data, records, and documentation to fully support a NASA investigation authority. The Supplier shall also work with the COTR to promptly identify and resolve any product issues.

- NASA with the assistance the Contractor shall ensure any contractor maintained area is controlled, safe, and not disturbed.

- The NASA Project and/or Quality Assurance shall ensure the Director of DFRC Safety and Mission Assurance is notified.

- The NASA Representatives, as identified/authorized by the NASA Center Management with Flight Operations responsibilities, shall impound all requested records.

In the event that an incident or accident happens, the Supplier shall upon request immediately provide data, records, all documentation requested to, and fully support investigation by, NASA/DFRC. In the event that National Transportation Safety Board (NTSB) or United States Air Force (USAF) is involved, this includes full cooperation with them as well.

The Supplier shall also work with the COTR to promptly identify and resolve any product issues.

If an incident/accident occurs the Supplier shall assist the COTR (and DFRC Safety) in processing as required by DCP-S-001, including filing DFRC Form 1627A NASA Initial Safety Incident Report.

If an incident/accident occurs it shall be processed as required by DCP-S-001. The following shall be performed immediately to preserve all evidence: (Those elements of DCP-S-001 should be added to the statement of work as a requirement giving specific actions to take.

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- The NASA Project and/or Quality Assurance shall ensure the Director of DFRC Safety and Mission Assurance is notified.

- The NASA Representatives, as identified/authorized by the NASA Center Management with Flight Operations responsibilities, shall impound all requested records.

43.0 SOFIA Program Surveillance Outline (QA Risk Mitigation)

The Supplier Quality Assurance program shall be designated and implemented in a manner that mitigates risk associated with noncompliance. The Supplier shall support the DFRC Quality Assurance aspects below. (Requirement, NPR 8000.4).

A. Risk Assessment. Identifies and assesses all aspects of the contract requirements and performance where there is an uncertainty regarding future events that could have a detrimental effect on the contract outcome and on NASA programs and projects. As the contract progresses, previous uncertainties will become known and new uncertainties will arise.

B. Risk Analysis. Once risks are identified, each risk should be characterized as to the likelihood of its occurrence and the severity of its potential consequences. The analysis should identify early warning signs that a problem is going to arise.

C. Risk Treatment. After a risk has been assessed and analyzed, something should be done about it. Alternatives include transfer, avoidance, reduction, assumption, and sharing.

D. Lessons Learned. After problems have been encountered, the Center should document any warning signs that, with hindsight, preceded the problem, what approach was taken, and what the outcome was. This should not only help future acquisitions, but help identify recurring problems in the existing contract.

44.0 Integrated Product Teams (IPTs)

Integrated Product Teams shall be formed to ensure efficient, competent, quick settlement of issues or expediting products where authorized by governing entities. Tiger Teams are IPTs with short duration.

The Supplier has no authority to commit personnel (or other government resources). Therefore, IPTs involving the government shall be authorized exclusively through the CO. The Supplier or NASA may initiate an IPT. Default information necessary for establishing an IPT includes:

A. Purpose ideally written as a mission statement with customer focus

B. Team membership by name (initially by function to gain permission to form the IPT) with participation levels expected (core team vs. support to IPT)

C. Organizational relationship (including at a minimum who the team reports to; expected support and/or reviewing organizations; roles and responsibilities; internal/external customers; etc.)

D. Duration (at a minimum start date and end criteria and/or date)

E. Authority (recommendation vs. team decision limits; facilitator/coach; chairperson and alternate chairperson; facility/website access permissions needed)

F. Priority level where practical

G. Expected products (e.g. minutes; action item list with assignees and due dates; documents, specifications; Mission/Vision Statement; cost/schedule input; risk/hazards identification/assessment; recommendations to supervising authority and Program/Project; change documentation; membership/contact roster; meeting schedule; published meeting notices with agendas; final report and/or presentation; etc.)

H. Team metrics (e.g. attendance; milestones; action item status; others as appropriate to the products expected)

IPTs are expected to be very focused, efficient teams. Members must be committed to fully support the IPT. To ensure efficiencies, competent alternates shall be identified. NASA encourages the following team ground rules and values in regard to IPTs:

- Focus on internal and external customer(s) expectations and objectives
- Cut to the chase, keep it simple
- Start and end meetings on time, following the agenda, consider rotating roles such as facilitator and scribe
- Take minutes, generate action items
- Base decisions and recommendations on facts and data, allowing every member to speak on subject, consider alternatives, then document

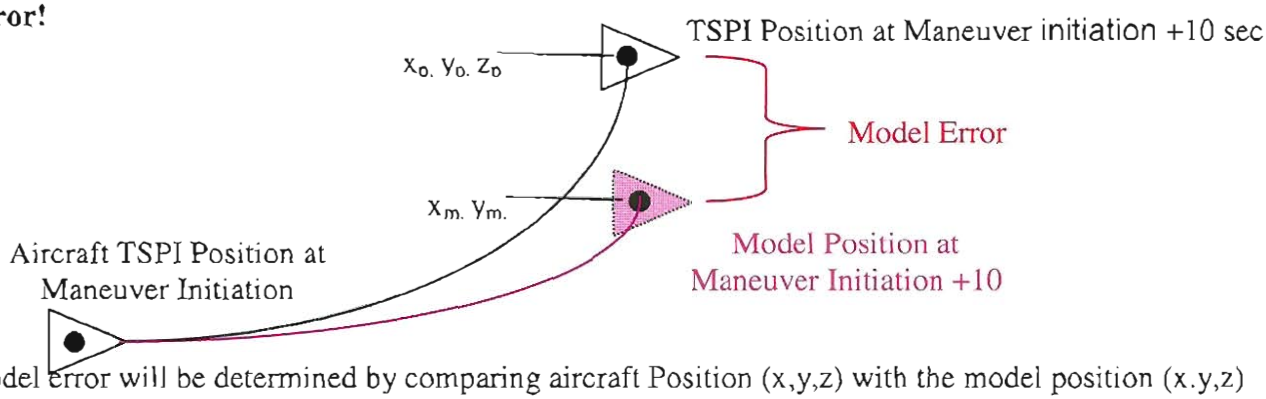
- Respect and listen to others, especially customers, working problems within the team, no overstepping conversations
- Consensus – apply "live with it" criteria before elevating issues to outside entities
- Be professional, do not violate processes without written permission/authority

Appendix A. Data Analysis Plan – Example

Data Analysis Plan Example (actually used on multi-industry project)

Aircraft Model Position Error (actual Time Space Position Information vs Simulation prediction)

Error!



Model error will be determined by comparing aircraft Position (x,y,z) with the model position (x.y,z) 10 seconds after evasion maneuver initiation. Model error will be determined for each test run.

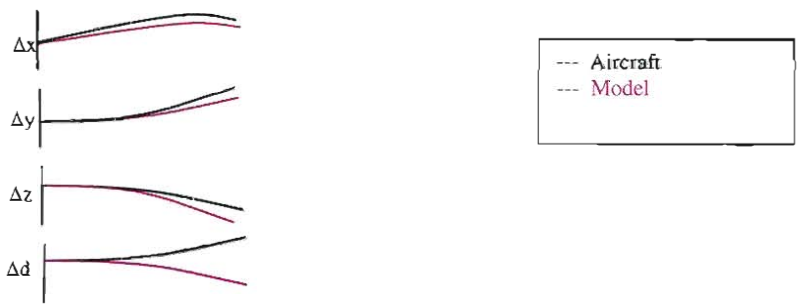
$\Delta x = x_p - x_M$

$\Delta y = y_p - y_M$

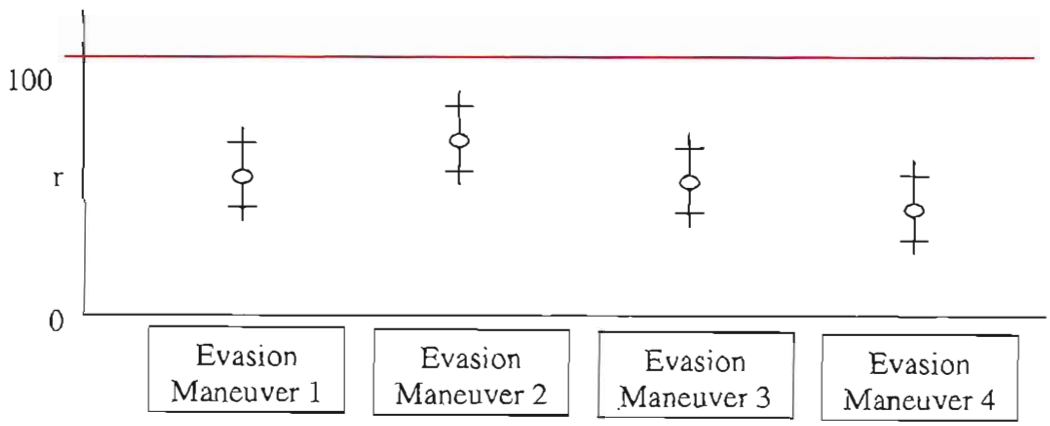
$\Delta z = y_p - y_M$

Model Error (r) $= (\Delta x^2 + \Delta y^2 + \Delta z^2)^{1/2}$

Time histories comparing the rate of change of the x, y and z components of r as well as the rate of change of the path distance d will also be generated.



The final data product will be a graph depicting maximum, standard deviation, average and minimum r for each evasion maneuver type.



Appendix B. Instrumentation Parameter List - SAMPLE

Book keeping comments	ParmID	Short Name (7 characters)	Description	Sample Rate (SPS)	Word Size (# bits)	Param bit rate Bps	EU Range Min	EU Range Max	Units	Criticality MC, FS, or TD	Accuracy (%FS)	Resolution (EU/Count)	Filter (hz)	Primary WG or POC	Justification
	Aero-Thermal														
CM	CF001V		3 axis vibration sensor 1-x	5000	12	60000	TBD	TBD	ft/sec^2	R	+/- 0.1	TBD	2 k Hz Low Pass	Aero-Thermal, Jerry Borrer/JSC	Required for acoustic model validation
CM	CF002V		3 axis vibration sensor 1-y	5000	12	60000	TBD	TBD	ft/sec^2	R	+/- 0.1	TBD	2 k Hz Low Pass	Aero-Thermal, Jerry Borrer/JSC	Required for acoustic model validation
CM	CF003V		3 axis vibration sensor 1-z	5000	12	60000	TBD	TBD	ft/sec^2	R	+/- 0.1	TBD	2 k Hz Low Pass	Aero-Thermal, Jerry Borrer/JSC	Required for acoustic model validation
CM	CF004V		3 axis vibration sensor 2-x	5000	12	60000	TBD	TBD	ft/sec^2	R	+/- 0.1	TBD	2 k Hz Low Pass	Aero-Thermal, Jerry Borrer/JSC	Required for acoustic model validation
CM	CF005V		3 axis vibration sensors 2-y	5000	12	60000	TBD	TBD	ft/sec^2	R	+/- 0.1	TBD	2 k Hz Low Pass	Aero-Thermal, Jerry Borrer/JSC	Required for acoustic model validation
CM	CF006V		3 axis vibration sensor 2-z	5000	12	60000	TBD	TBD	ft/sec^2	R	+/- 0.1	TBD	2 k Hz Low Pass	Aero-Thermal, Jerry Borrer/JSC	Required for acoustic model validation
CM Placeholder			Surface Pressure Measurement # 95	50	12	600	-15	15	psid	R	+/- 0.1	0.00732 psi/count		Aero-Thermal Kevin Johson	Required for aerodynamic model validation
CM Placeholder			Surface Pressure Measurement # 96	50	12	600	-15	15	psid	R	+/- 0.1	0.00732 psi/count		Aero-Thermal Kevin Johson	Required for aerodynamic model validation

Remarks	Location (x, y, z)	Data Type	Related Mission or Flight Test Objective	Sensor Mfr.	Sensor Output	PS Module	PS Port #	Elect. Dwg.	Instl'n Dwg.	Telemtry Downlink	On-Board RCRDR	PCM STRM 1	PCM STRM 2	Priority	Total Sensor Count per type	Freq Response Hz	Data Destination	Secondary WGs or POCs
	TBD	OB												1.1				
	TBD	OB												1.2				
	TBD	OB												1.2				
	TBD	OB												1.2				
	TBD	OB												1.3				
	TBD	OB												2.1				
Ref. K.J. 10/12/06 Email Item 1.a (20 extra static press)	0 Deg, x/d=0.3467	OB									Y			2.1				
Ref. K.J. 10/12/06 Email Item 1.a (20 extra static press)	0 Deg, x/d=0.48	OB									Y			2.2				

ParamID=Parameter Identification, SPS=Samples per second, EU=Engineering Units, MC=Mission Critical, FS=Flight Safety, TD=Technically Desirable, PS=Pressure Scanning, PCM=Pulse Code Modulation, STRM=Stream